The Journal of THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

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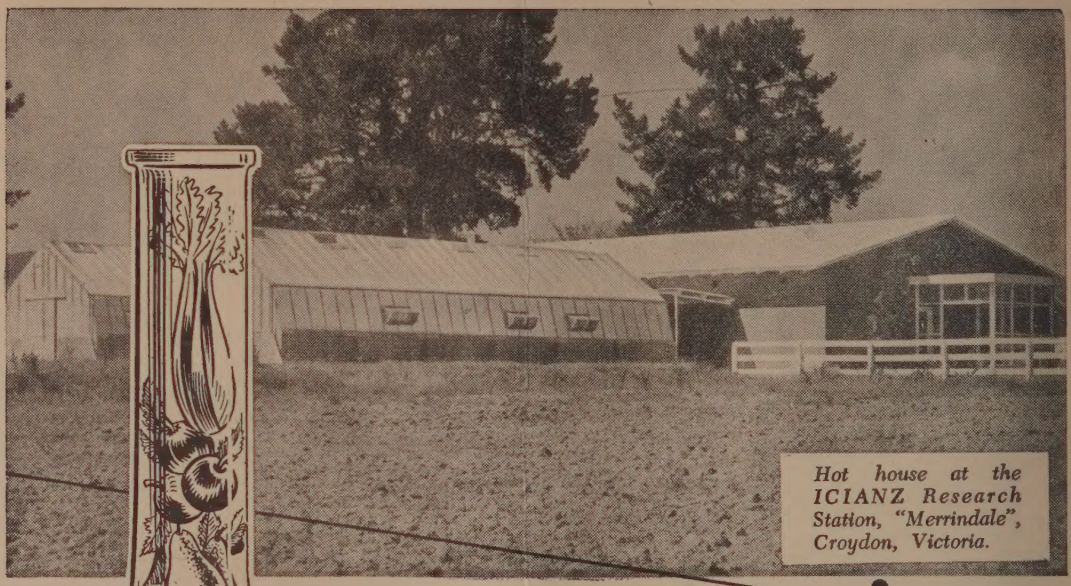

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ARTICLES

THE UTILISATION OF LOW-QUALITY PASTURE

By M. C. FRANKLIN, P. K. BRIGGS and G. L. McCLYMONT

A pasture which fails to maintain satisfactory production in livestock because of a specific deficiency, excess or imbalance of essential nutrients, may be regarded as of low-quality.

Extensive references to nutritional deficiencies which can occur in pastures are to be found in the Australian scientific literature. Some effects of deficiencies of vitamin D, energy and protein will be discussed here. These deficiencies are revealed by studies of bodyweight and bio-chemical changes, wool production, and the response of sheep and cattle to various supplements.

Vitamin D Deficiency in Grazing Sheep

It is now well established that a vitamin D deficiency may limit production by sheep in Australia. The grazing conditions under which this deficiency may occur, its effect on production and methods of its control have all been studied (Ewer, 1953; Franklin, 1951, 1953; Green, 1953).

The problem of vitamin D deficiency in the grazing animal is not a simple one. Grant (1954) has shown that the vitamin D requirements are increased with an increase in the carotene or vitamin A intake. For example, in weaners grazing on high-quality green feed with carotene levels as high as 782 γ/g. dry matter (Grant, *ibid*), the normal daily requirement of 180-200 International Units of vitamin D per 100 lb. bodyweight (Andrews and Cunningham, 1945) is inadequate.

For obvious reasons a vitamin D deficiency is more likely to occur during the winter or early spring months in the more Southern latitudes in Australia, such as Tasmania. However, instances of vitamin D deficiency have also been recorded on the mainland. A number of cases of rickets in ram lambs have been reported in the Riverina District, N.S.W., and a significant response to vitamin D supplements was obtained in weaners grazing on green-feed oats on the C.S.I.R.O. McMaster Field Station at Badgery's Creek near Sydney (Franklin, 1953).

The occurrence of clinical rickets is the more obvious manifestation of vitamin D deficiency under certain grazing conditions, but is probably much less important than the loss in production. This can be assessed by careful experiments in which massive vitamin D supplementation has been the only difference between treated and control groups. The data in Tables I and II are typical of the results which have been obtained in these experiments.

The main points of interest in the experiment at "Vaucluse" in 1947 were the occurrence of a severe hypocalcaemia and hypophosphataemia, slower liveweight gains and the occurrence of clinical rickets in sheep which were not given a vitamin D_2 supplement.

In the experiment at "Frodsley" in 1949, similar data were collected and also comparative data on wool production.

M. C. FRANKLIN, M.Sc., Ph.D., is William McIlwrath Fellow in Animal Husbandry and P. K. BRIGGS, B. Sc. Agr., is Research Officer, both stationed at the McMaster Laboratory, Division of Animal Health and Production, C.S.I.R.O., Sydney. G. L. McCLYMONT, B.V.Sc., Ph.D., was Special Veterinary Research Officer with the New South Wales Department of Agriculture Veterinary Research Station, Glenfield, New South Wales but has since been appointed Professor of Rural Science with the University of New England, New South Wales.

TABLE I.

The effect of vitamin D_2 on Corriedale weaners grazing green-feed oats, "Vaucluse", Tasmania.

	Group*	
	Control, no vitamin D_2	Treated with 10^6 I.U. vitamin D_2 twice, on 15/5/47 and 10/7/47
Mean liveweight—		
15/5/47	47.6 lb.	47.2 lb.
28/8/47	59.6 lb.	66.8 lb.
Liveweight increase over 15 weeks	12.0 lb.	19.6 lb.
Mean serum calcium—		
15/5/47	11.4 mg/100 ml	11.4 mg/100 ml
28/8/47	7.9 mg/100 ml	9.9 mg/100 ml
Mean serum inorganic phosphorus—		
15/5/47	6.5 mg/100 ml	6.0 mg/100 ml
28/8/47	4.4 mg/100 ml	6.4 mg/100 ml
Number of lame sheep in groups at end of experiment—clinical rickets	7 cases	Nil

*Each group contained twenty-five weaners.

TABLE II.

The effect of improved winter grazing and vitamin D_2 treatment of Corriedale weaners, "Frodsley", Tasmania.

Group	Treatment	Bodyweight			Wool Weight
		28/4/49	7/9/49	17/10/49	17/10/49
		lb	lb	lb	lb
1	Improved pasture continuously (limited winter growth), plus supplement* of dry feed in winter of 1949	59.6	56.2	62.2	6.71
2	Green-feed oats plus subterranean clover from 29/4/49 to 7/9/49 (132 days) (*No* vitamin D_2 supplement)	59.8	94.0	89.3	8.99
3	Grazing treatment similar to Group 2 plus vitamin D_2†	59.9	100.7	94.3	10.03

*Each weaner in group 1 received approximately 60 lb wheat plus 85 lb hay or chaff as supplementary feed.

†10^6 I.U. of vitamin D_2 on 28/4/49 and 12/7/49.

Differences in grazing management for the three groups included in Table II pertained only to the 132-day period from April 28, 1949, to September 7, 1949. Prior to and following this period all groups grazed together.

On October 17, 1949, 40 days after the termination of the winter feeding experiment, the weaners were shorn. Those in group 2 cut 34 per cent. more wool than those of group 1, and those in group 3 cut 49.5 and 11.5 per cent. more than those of groups 1 and 2 respectively. Obviously, the pasture and supplementary feeding of the weaners in group 1 was inadequate for satisfactory growth and wool production.

The problem of the vitamin D requirements of grazing sheep is complicated by the quality and quantity of the feed, locality and environment, season, time of lambing, wool cover, age and condition of the sheep, and the carotene and vitamin D_2 content of the pastures. Later experiments have studied a number of these factors (Franklin, 1951, 1953; Green, 1953). However, sufficient data have been included here to show that young, succulent pasture or green-feed oats of high energy and protein content and rich in minerals and carotene may, under some conditions, fail to promote optimum production when grazed by sheep, because it is deficient in vitamin D_2.

The Influence of Pasture Quality on Beef Production in Australia

Experimental work has been in progress now for some years to measure the performance of beef cattle in the Australian environment. Cattle weighing centres have been established in all States and in the Northern Territory, and regular monthly weighings of cattle from weaning to maturity have provided useful data on seasonal changes in the nutritive value of the pasture. Discussion here will be restricted mainly to the work carried out in the southern states, including New South Wales, Victoria, South Australia, Western Australia and Tasmania.

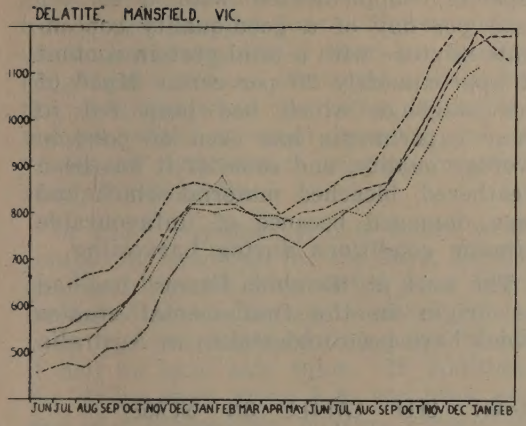
Twelve centres have been established in typical beef producing areas in these states, and data have been collected since 1950. Progress reports have been published (Hewitt, 1953; Muirhead and Allden, 1952a, 1952b; Bignell and Meldrum, 1952; Pillinger and Kelly, 1954) and more recently a full summary (Franklin, 1955a).

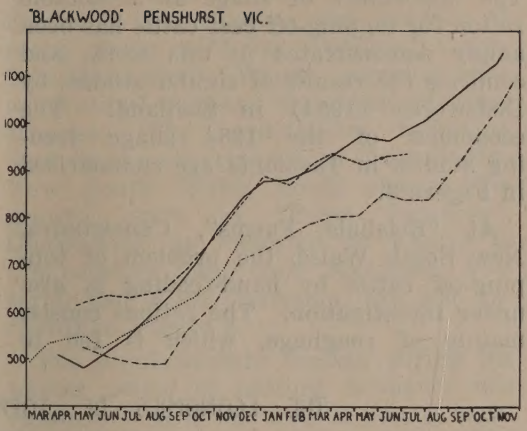
More intensive investigations have been undertaken at some of the centres to study the effect of supplementary and of complete hand-feeding during periods of nutritional stress when the pasture is qualitatively and quantitatively inadequate. The complete hand-feeding studies have included stall and yard-feeding experiments in New South Wales and stall-feeding experiments in Tasmania.

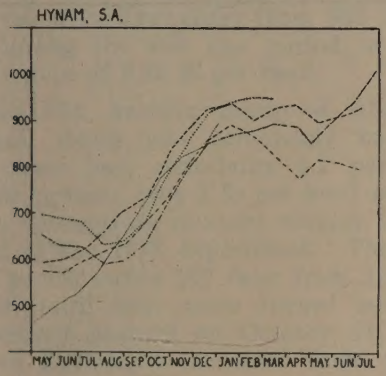
Data from Mansfield in north-eastern Victoria, Hynam in the south-east of South Australia, and from Pardelup in the southern District in Western Australia are included in Figure 1, to illustrate the rapid change in pasture quality in December or January of each year, and static or falling bodyweights are normal sequelae during the following six to nine months. These contrast with the more satisfactory growth rates of cattle at Penshurst in western Victoria and at Ross and Glenora in Tasmania as shown in Figure 2.

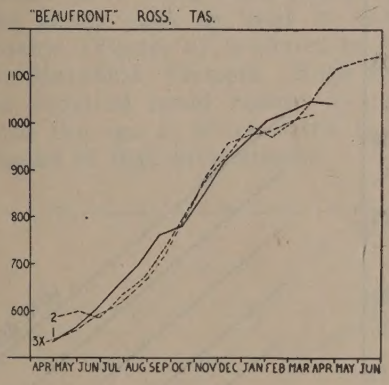
In some instances complete hand-feeding has been adopted when relatively small gains are necessary to reach a suitable slaughter grade, and increasing interest in this technique is being shown in Australia.

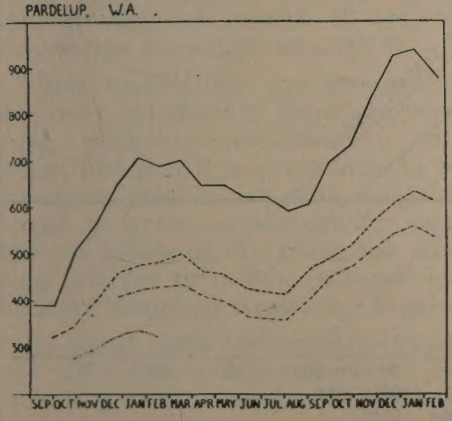
The results of a number of these topping-off studies have been summarised (Franklin, 1955b), and data are available on liveweight gains, food consumption, and carcase weights. These investigations have included yard-feeding experiments during the winter months of pasture dormancy at Glenora, Tasmania, and comparative data have been obtained on rations of roughage and concentrates and on good-quality grass-clover silage.











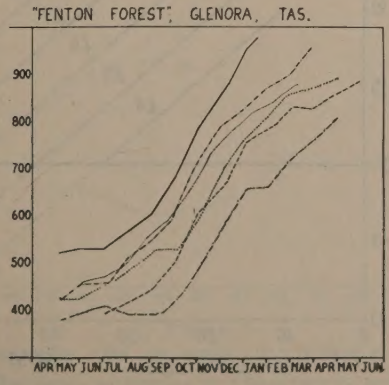


Figure 1.

The effect of change in pasture quality on the mean bodyweight of steers, based on data collected 1950-55 from three different centres. Each line represents the mean bodyweight of a group of approximately twenty-five animals.

Figure 2.

Growth of steers on pasture under favourable environmental conditions. The changes in bodyweight are based on data collected 1951-55. Each line represents the mean bodyweight of a group of approximately twenty-five animals.

The importance of silage as a suitable ration for topping-off beef cattle has been amply demonstrated in this work, and confirms the results of similar studies by Dodsworth (1954) in Scotland. The economics of the 1954 silage feeding studies in Tasmania are summarised in Figure 3.

At "Belabula Farms", Canowindra, New South Wales, the problem of topping-off cattle by hand-feeding is also under investigation. The rations consist mainly of roughage, which is fed to capacity, supplemented with 3 lb per head per day of a good-quality concentrate mixture with a total protein content of approximately 20 per cent. Much of the roughage which has been fed in these experiments has been of poor to average quality, and some of it has been weathered, bleached material which had been damaged because of unfavourable climatic conditions during harvesting.

The work at "Belabula Farms" has had its origin in the fundamental studies which have been undertaken in Australia

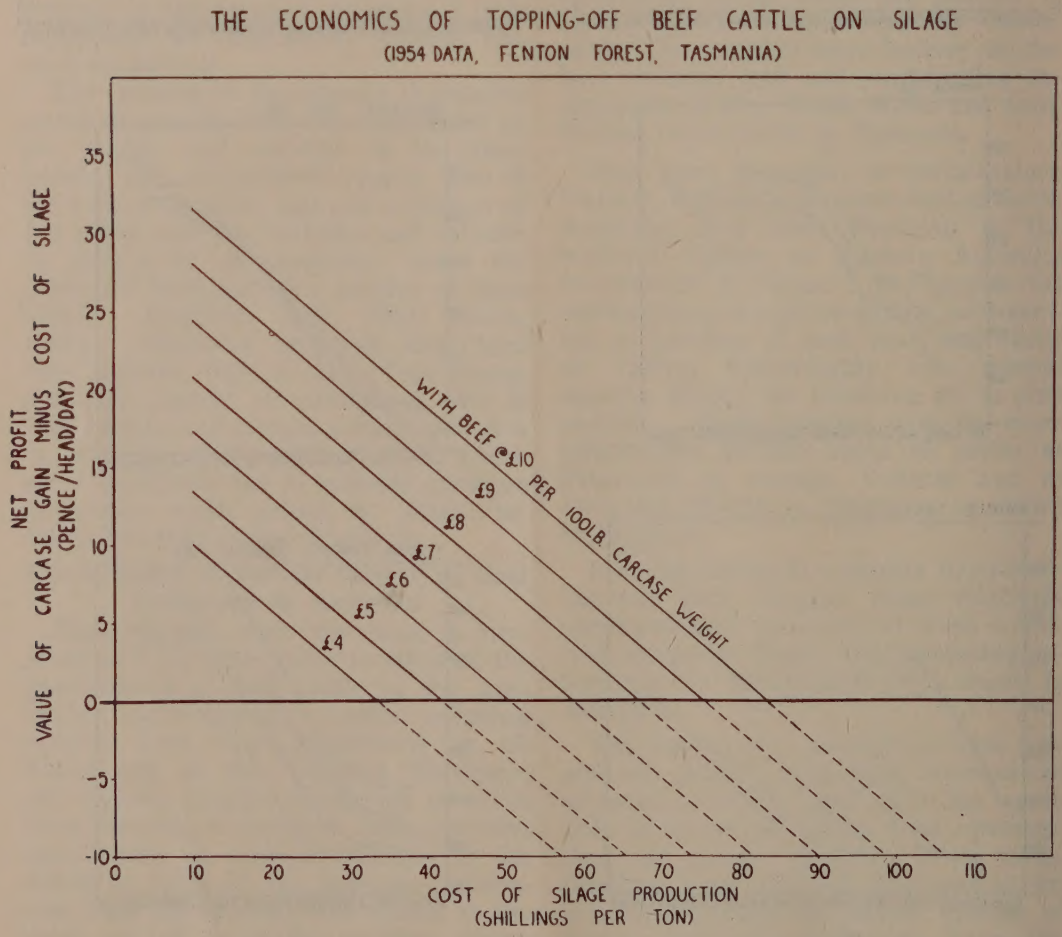


Figure 3.

The economics of topping-off beef cattle on silage. Labour charges of feeding and other feed-lot costs have not been included but, under the conditions at Fenton Forest, it was estimated that these would not exceed three pence per head per day.

and overseas on the effect of good nutrition on the ruminal flora. These experiments have established that low-quality roughages are more efficiently utilised by the ruminant when the ration is supplemented with a small quantity of a "balanced" concentrate mixture or even single concentrates.

In 1953, Aberdeen Angus steers were completely hand-fed, for 108 days, mainly on lucerne-grass hay which had been harvested under adverse weather conditions and was damaged to a point where it had no local sale value. In addition, the steers were given 3 lb per head per day of a concentrate mixture containing 20 per cent. crude protein. The steers increased in liveweight from 658 to 902 lb during the 108 day period, a mean daily gain of 2.25 lb per head.

In 1954, another group of Aberdeen Angus steers was completely hand-fed on oaten hay, containing 5.2 per cent. crude protein, plus 3 lb per head per day of a concentrate mixture similar to that used in the 1953 experiment. The feeding period lasted 107 days from June 26, 1954, until they were turned out onto improved pasture on October 11, 1954. Mean liveweight increased from 577 to 756 lb, a daily gain of 1.67 lb. These steers were marketed 16 weeks later, at approximately 18 months of age, when the average liveweight was 935 lb.

These experiments are demonstrating that very satisfactory gains are possible using minimum quantities of concentrates, and that it is practicable to avoid the severe check which cattle suffer when forced to graze on low-quality pasture. The magnitude of this check has already been referred to in data collected in the southern States of Australia (Figure 1).

In many parts of northern Australia this problem is even more serious. Satisfactory growth is obtained in cattle during the wet summer months and for a short time thereafter, but a serious loss in condition occurs during the "dry" when the nutritive value of the pasture often falls to a low level. The data in Figure 4 summarising the growth of young steers at "Brian Pastures", Gayndah, Queensland (Young, personal communication) indicate the extent of these changes. The yard-feeding technique used in the experiments at Canowindra, New South Wales, could change the growth curve at "Brian Pastures", Queensland, as indicated in Figure 4. Comparative data from Mansfield, Victoria, and Ross, Tasmania, are also included in Figure 4.

The supplementary feeding during the winter period of pasture dormancy has resulted in early maturity of young, high-quality beef at Ross, Tasmania. The potential gain using high-quality grass-clover silage such as used at Glenora, Tasmania (Figure 3) is shown in Figure 4 for Mansfield, Victoria. Such feeding when required could reduce by several months the age at which cattle could be marketed in that environment.

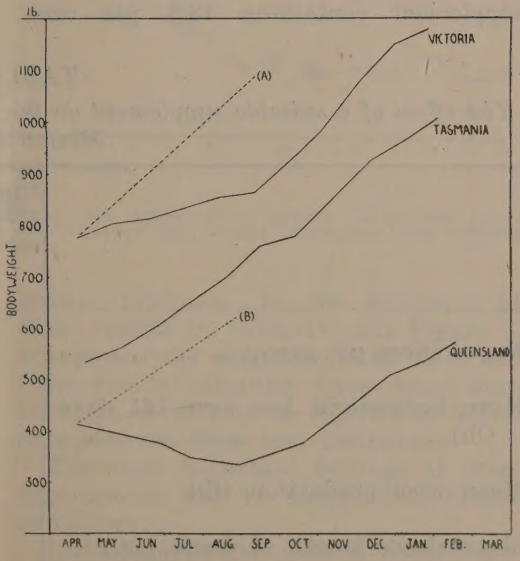


Figure 4.

Comparative data on actual and potential growth rates of steers.

Growth rates on pasture at "Beaufront", Ross, Tasmania, "Delatite", Mansfield, Victoria, and "Brian Pastures", Gayndah, Queensland.

Potential gains (A) on grass-clover silage only (data from Glenora, Tasmania), and (B) on cereal roughage plus small quantities of a concentrate mixture (data from Canowindra, N.S.W.).

These are examples of some of the feeding techniques which may be adopted more widely for the better utilisation of low-quality pasture by beef cattle. Economic conditions within the industry, and the extent of the demand for young, high-quality beef will influence the application of these findings to the beef industry.

The Utilisation of Low-Quality Roughage by Sheep

The utilisation of low-quality roughage by sheep has been under investigation by C.S.I.R.O. and the New South Wales Department of Agriculture since the latter part of 1952. Preliminary experiments in that year were disappointing, with the exception of one group of Merino wethers which received 5 oz of lucerne chaff per day as a supplement to a basal ration of low-quality cereal straw chaff containing 1.2 per cent. crude protein.

A second series of experiments was commenced in December, 1953. A mixed supplement containing 18.9 per cent. crude protein was used, and by appropriate admixture with wheaten chaff the protein content of the roughage was raised to 3.5 per cent. The concentrate supplement which was given at the rate of 4.0 oz per head per day, at daily, twice-weekly and weekly intervals, to adult Merino wethers, contained lucerne chaff 40, whole wheat 30, linseed meal 20, molasses 9, cobaltised* salt 1 part by weight plus 600 I.U. vitamin A per 4 oz of the supplement. The results of this experiment, which lasted six months, are summarised in Figure 5 and Table III.

Utilisation of the low-quality roughage was considerably improved by the addition of only 4 oz of the above supplement per head per day. Survival rate, bodyweight, wool production and roughage consumption were significantly increased compared with the performance of the wethers receiving no supplement.

To gain additional information on the suitability of other supplements, par-

*To supply 1 mg cobalt per head per day.

TABLE III.

The effect of a suitable supplement on the utilisation of low-quality roughage by Merino wethers.

	Interval of supplement feeding			Control, no supplement
	Daily	Twice weekly	Weekly	
No. of sheep per group	24	23	24	16
Mean bodyweight loss over 181 days (lb)	6.2	7.5	11.3	30.4
Mean wool production (lb)	6.69	6.50	6.25	5.19
Mean staple length of fleece (in.)	2.71	2.67	2.57	2.04
Mean quantity of low-quality roughage consumed per day over 181 days (lb)	1.58	1.47	1.25	0.99
Survival rate (per cent.)	100	95.6	95.8	75

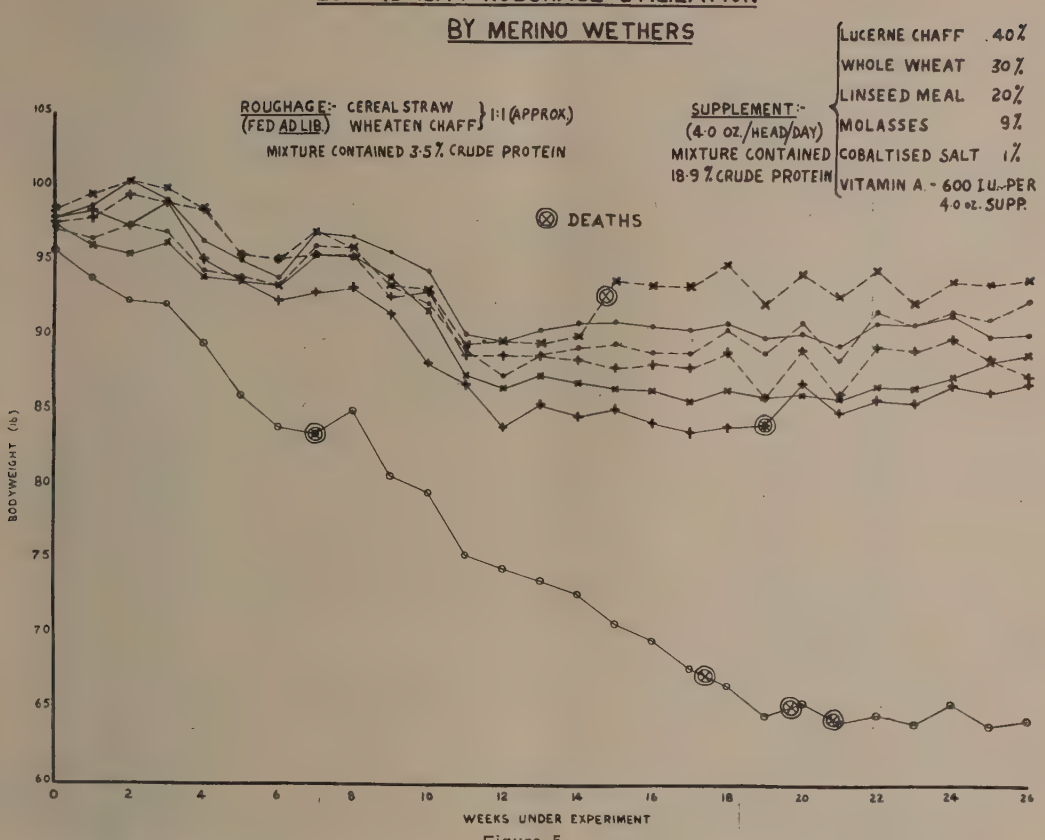

LOW-QUALITY ROUGHAGE UTILIZATION
BY MERINO WETHERS
ROUGHAGE:- (FED AD LIB.) CEREAL STRAW / WHEATEN CHAFF } 1:1 (APPROX.)
MIXTURE CONTAINED 3·5% CRUDE PROTEIN
SUPPLEMENT:- (4·0 OZ./HEAD/DAY) MIXTURE CONTAINED 18·9% CRUDE PROTEIN
LUCERNE CHAFF 40%
WHOLE WHEAT 30%
LINSEED MEAL 20%
MOLASSES 9%
COBALTISED SALT 1%
VITAMIN A - 600 I.U. PER 4·0 OZ. SUPP.
DEATHS
BODYWEIGHT (lb.)
WEEKS UNDER EXPERIMENT

Figure 5.

The utilisation of low-quality roughage by Merino wethers. Six supplemented groups maintained bodyweight over last sixteen weeks of experiment whereas control group lost weight throughout and suffered heavy losses.

ticularly individual feedstuffs, and of the effectiveness of urea as a protein substitute, a third series of experiments with 2-tooth Merino ewe weaners was commenced in September, 1954.

The sheep were fed *ad lib.* on two types of low-quality roughage, namely, chaffed oaten straw, and chaffed oaten straw plus wheaten chaff containing 2.4 and 3.5 per cent. crude protein respectively. Supplemented groups were given either lucerne chaff, concentrate mixture similar to that provided in the previous experiment, linseed oilmeal, cracked wheat plus limestone, or cracked wheat plus limestone plus urea plus sulphate. The supplements were fed at daily or twice-weekly intervals. In the summary of these results in Table IV and Figure 6, groups fed the supplements at daily and twice-weekly intervals have been combined as there was no significant difference between these two treatments.

The more important findings of these experiments may be summarised briefly as follows:—

1. Unsupplemented control groups suffered a high mortality rate. The survivors lost a considerable amount of bodyweight and their wool production was significantly lower than that of the supplemented groups. Roughage consumption declined as the experiment progressed.

TABLE IV.

The effect of various supplements on the utilisation of low-quality roughage by Merino weaners.

	Oaten straw ad lib. containing 2.4 per cent. crude protein						Wheaten chaff-oaten straw mixture ad lib. containing 3.5 per cent. crude protein					
Supplement*	Control, no supplement	Linseed meal	Lucerne chaff	Concentrate mixture	Wheat	Wheat + urea +sulphate	Control, no supplement	Linseed meal	Lucerne chaff	Concentrate mixture	Wheat	Wheat + urea +sulphate
No. of sheep per group	24	38	40	40	39	40	24	40	40	39	40	40
No. of survivors:—												
Total	Nil†	36	30	29	21	26	9	39	38	38	29	31
Percentage	Nil	94.7	75.0	72.5	53.8	65.0	37.5	97.5	95.0	97.4	72.5	77.5
Mean bodyweight change over 167 days (lb)	—	+2.7	—0.5	—1.4	—6.8	—3.9	—8.2	+5.5	+2.2	+1.5	—3.8	—0.7
Mean wool production (lb)	—	3.19	3.00	2.87	2.37	2.56	2.44	3.75	3.12	3.25	2.88	3.19
Mean quantity of roughage consumed per day (lb):—												
8/9/54-15/10/54 (37 days)	0.86	1.10	0.78	0.94	0.87	0.98	1.08	1.27	1.03	1.31	1.19	1.16
16/10/54-5/1/55 (82 days)	0.73	1.04	0.71	0.83	0.66	0.84	0.91	1.19	0.97	1.08	0.86	0.98
6/1/55-4/2/55 (30 days)	—	1.07	0.92	0.84	0.62	0.81	0.81	1.18	0.99	1.00	0.72	0.88
5/2/55-22/2/55 (18 days)	—	1.00	0.80	0.85	0.69	0.66	0.60	1.20	0.95	1.02	0.87	0.70
8/9/54-22/2/55 (167 days)	—	1.06	0.77	0.86	0.71	0.85	0.90	1.21	0.98	1.10	0.92	1.00

*The supplements were fed at the following levels: Linseed meal 3.1 oz; lucerne chaff 6.1 oz; concentrate mixture 4.0 oz. (See footnote Table 5 for composition of concentrate mixture); wheat 3.1 oz; and wheat 3.1 oz plus urea 6.25 g plus Na_2SO_4 0.15 g per weaner per day.

†The survivors, totalling 21 per cent. of the control group with access to roughage containing 2.4 per cent. crude protein, were removed from the experiment after 104 days. None of these animals would have survived the full 167-day experimental period.

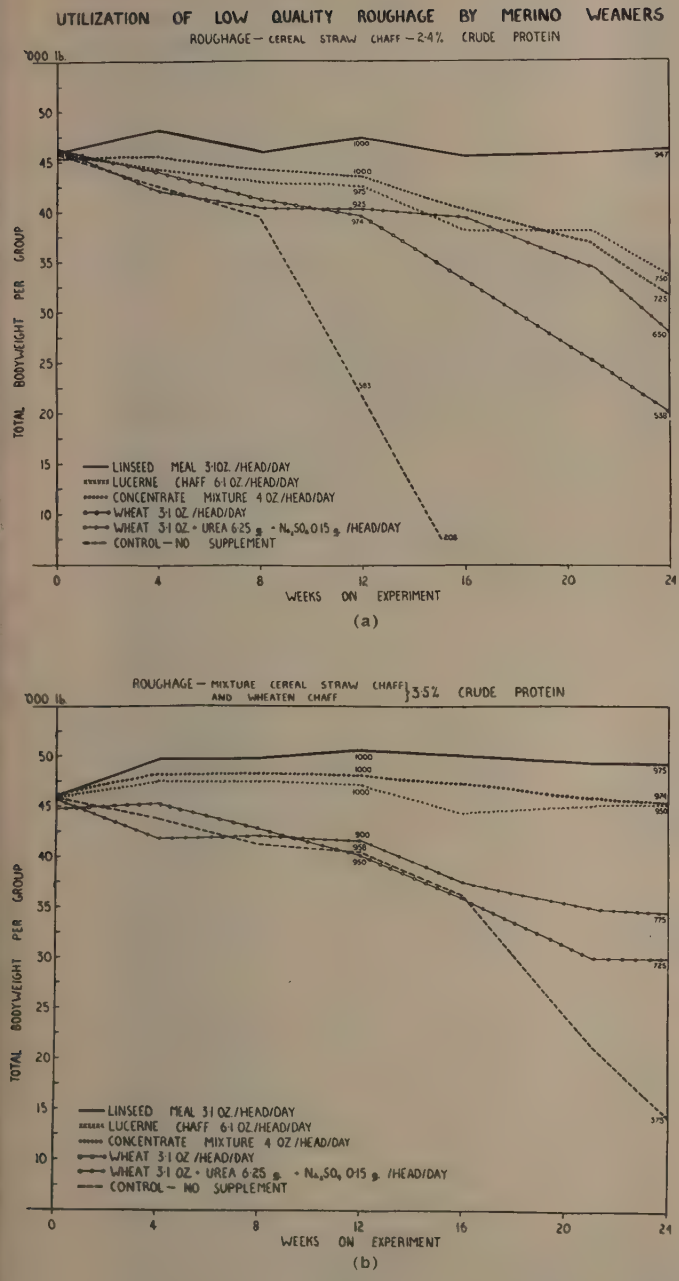

UTILIZATION OF LOW QUALITY ROUGHAGE BY MERINO WEANERS
ROUGHAGE — CEREAL STRAW CHAFF — 2·4% CRUDE PROTEIN
'000 lb.
TOTAL BODYWEIGHT PER GROUP
WEEKS ON EXPERIMENT
LINSEED MEAL 3·1OZ./HEAD/DAY
LUCERNE CHAFF 6·1 OZ./HEAD/DAY
CONCENTRATE MIXTURE 4 OZ./HEAD/DAY
WHEAT 3·1 OZ./HEAD/DAY
WHEAT 3·1 OZ. + UREA 6·25 g. + N_2SO_4 0·15 g. /HEAD/DAY
CONTROL — NO SUPPLEMENT
(a)
ROUGHAGE — MIXTURE CEREAL STRAW CHAFF AND WHEATEN CHAFF } 3·5% CRUDE PROTEIN
'000 lb.
TOTAL BODYWEIGHT PER GROUP
WEEKS ON EXPERIMENT
LINSEED MEAL 3·1 OZ./HEAD/DAY
LUCERNE CHAFF 6·1 OZ./HEAD/DAY
CONCENTRATE MIXTURE 4 OZ./HEAD/DAY
WHEAT 3·1 OZ./HEAD/DAY
WHEAT 3·1 OZ. + UREA 6·25 g. + N_2SO_4 0·15 g. /HEAD/DAY
CONTROL — NO SUPPLEMENT
(b)

Figure 6.
The effect of various supplements on the utilisation of low-quality roughage by Merino weaners calculated on the basis of 1,000 sheep per group. Number of survivors at 12 and 24 weeks are included for each treatment.
(a) When fed ad lib. on cereal straw chaff containing 2.4 per cent. crude protein.
(b) When fed ad lib. on a mixture of cereal straw chaff and wheaten chaff containing 3.5 per cent. crude protein.

2. Losses were negligible in many of the supplemented groups, especially those which had access to roughage containing 3.5 per cent. crude protein. Wool production and roughage consumption were significantly higher in the supplemented groups. In most of the treatments, except wheat and wheat+urea+sulphate (see Table 4), the average daily roughage consumption did not decrease significantly throughout the experiment.
3. The performance of the supplemented groups was similar whether the supplements were given at daily, twice-weekly or weekly intervals in the 1953-54 experiment, and whether at daily or twice-weekly intervals in the 1954-55 experiment.

Economic Considerations and Conclusions

One of the main objectives in these studies has been the investigation of methods of preventing the disastrous losses in body condition and the high mortality rate which occurs when sheep or cattle graze on or are fed low-quality roughage for long periods. Consideration of the data obtained and presented here has been extended to include the economic aspects of the problem.

The results presented in Tables III and IV provided the basis for the economic data in Tables V and VI.

The following important points are illustrated by the data in Tables V and VI.

1. Age is an important factor in the ability of sheep to utilize low-quality roughage satisfactorily.
2. Weaners cannot normally subsist for long periods on roughage containing only 2.4 per cent. crude protein, but the addition of one of a number of suitable supplements makes the feeding of this roughage practicable.
3. Increasing the crude protein of the roughage to 3.5 per cent. by the admixture of average quality cereal chaff resulted in considerably better results in all treatments.

4. A small supplement of linseed meal gave consistently good results in all groups. A concentrate mixture which contained 18.9 per cent. crude protein and lucerne chaff, also gave satisfactory results.

5. Wheat grain was not a satisfactory supplement with the low-quality roughage fed in these experiments. The mortality rate was high, and the costs of feeding were much higher than with the other supplements.

TABLE V.

The economics of the effect of a suitable supplement on the utilisation of low-quality roughage by Merino wethers.

(Calculated on the basis of 1000 sheep per group)

	Wheaten chaff-oaten straw mixture *ad lib.* containing 3.5 per cent. crude protein	
	Control, no supplement	4.0 oz concentrate mixture per head per day*
Survivors after 181 days	750	972
Wool:—		
Average weight per sheep (lb)	5.19	6.38
Total weight per group (lb)	3892	6201
Gross return at 72.8d. per lb†	£1180	£1881
Loss from deaths at £3/10/- per head‡	£875	£98
Fodder eaten:—		
Roughage (tons)	79.7	123.8
Concentrate mixture (short tons)	Nil	22.4
Fodder costs:—§		
Roughage	£797	£1238
Concentrate mixture	Nil	£672
Total	£797	£1910
Total costs (181 days):—		
Fodder + deaths less wool return	£492	£127
Net cost per head based on survivors	13/2d.	2/7d.

*Based on composite data from groups given the concentrate mixture daily, twice-weekly and weekly (see Table III and Figure 9). The concentrate mixture contained lucerne chaff 40, whole wheat 30, linseed meal 20, molasses 9, cobaltised salt 1 part by weight plus 600 I.U. vitamin A per 4 oz of the mixture.

†Based on average Australian wool price for 10-month period ending April 30, 1955.

‡Actual purchase price.

§Based on roughage £10 per ton; lucerne chaff £30/16/- per ton; wheat 16/- per bushel; linseed meal £45 per short ton; molasses £1/5/- per cwt; salt 16/6 per cwt.

TABLE VI.

The economics of the effect of various supplements on the utilisation of low-quality roughage by Merino weaners.

(Calculated on the basis of 1000 sheep per group.)

	Oaten straw ad lib. containing 2.4 per cent. crude protein						Wheaten chaff-oaten straw mixture ad lib. containing 3.5 per cent. crude protein					
Supplement*	Control, no supplement	Linseed meal	Lucerne chaff	Concentrate mixture	Wheat	Wheat + Urea + Sulphate	Control, no supplement	Linseed meal	Lucerne chaff	Concentrate mixture	Wheat	Wheat + Urea + Sulphate
Survivors after 167 days	Nil**	947	750	725	538	650	375	975	950	974	725	775
Wool—												
Average weight per sheep (lb)	—	3.19	3.00	2.87	2.37	2.56	2.44	3.75	3.12	3.25	2.88	3.19
Total weight per group (lb)	—	3021	2250	2081	1275	1664	915	3656	2964	3165	2088	2472
Gross return at 72.8d. per lb†	—	£916	£682	£631	£387	£505	£278	£1109	£899	£960	£633	£750
Loss from deaths at £3/8/- per head‡	£3400	£180	£850	£935	£1570	£1190	£2125	£85	£170	£88	£935	£765
Fodder eaten—												
Roughage (tons)	35.9	73.9	57.9	63.7	53.7	63.1	58.2	89.5	73.3	83.9	68.2	74.4
Supplement (short tons)	Nil	16.0	29.3	19.8	14.2	15.8	Nil	16.3	31.2	20.8	14.6	15.1
Fodder costs§—												
Roughage	£359	£739	£579	£637	£537	£631	£582	£895	£733	£839	£682	£744
Supplement	Nil	£720	£806	£594	£379	£487	Nil	£733	£858	£624	£389	£464
Total	£359	£1459	£1385	£1231	£916	£1118	£582	£1628	£1591	£1463	£1071	£1208
Total costs (167 days)—												
Fodder + deaths less wool return	£3759	£723	£1553	£1535	£2099	£1803	£2429	£604	£862	£591	£1373	£1223
Net cost per head based on survivors	—	15/3d.	£2/1/5	£2/2/4	£3/18/-	£2/15/6	£6/9/6	12/5d.	18/2d.	12/2d.	£1/17/11	£1/11/7

*The supplements were fed at the following levels: Linseed meal 3.1 oz; lucerne chaff 6.1 oz; concentrate mixture 4.0 oz (see footnote to Table V for composition of concentrate mixture); wheat 3.1 oz; and wheat 3.1 oz plus urea 6.25 g plus Na_2SO_4 0.15 g per weaner per day.

†Based on average Australian wool price for 10-month period ending April 30, 1955.

‡Actual purchase price.

§Based on roughage £10 per ton; linseed meal £45 per short ton; lucerne chaff £30/16/- per ton; concentrate mixture £30 per ton; wheat 16/- per bushel; urea 9d. per lb; sodium sulphate 6/6 per lb.

**The survivors, totalling 21 per cent. of the control group with access to roughage containing 2.4 per cent. crude protein, were removed from the experiment after 104 days. None of these animals would have survived the full 167-day experimental period.

6. The addition of urea and sulphate to the wheat rations gave consistently better results. It is pertinent to mention that these would have been still better had losses from urea poisoning not occurred at two stages of the experiment.

7. The results have demonstrated that sheep may be fed for long periods on low-quality roughage and suitable supplements at a relatively low cost. The application of these results to drought conditions is obvious.

8. The data summarised in Tables V and VI show results ranging from a complete loss of all stock on the low-quality roughage only, to negligible losses with groups supplemented with linseed meal, a suitable concentrate mixture or lucerne chaff.

Although some of the supplements used in these experiments may be unobtainable in certain areas, the data disclose a series of feeding techniques which are successful in alleviating nutritional stress on low-quality pasture.

References.

Andrews, D. and Cunningham, I. J. (1945)—*N.Z. J. Sci. Tech.*, 27: 223.

Bignell, J. T. and Meldrum, G. K. (1952)—*Tasm. J. Agric.*, 23: 326.

Dodsworth, T. L. (1954)—*J. Agric. Sci.*, 44: 383.

Ewer, T. K. (1953)—*Aust. Vet. J.*, 29: 310.

Franklin, M. C. (1951)—In Australia. Commonwealth Scientific and Industrial Research Organization. School for sheep and wool extension officers. Handbook for interstate research sessions, 10th-14th September, 1951, C.S.I.R.O., Melbourne.

Franklin, M. C. (1953)—*Aust. Vet. J.*, 29: 302.

Franklin, M. C. (1955a)—"Beef cattle investigations in the southern states of Australia". Roneoed report prepared for 19th Meeting Australian Committee on Animal Production. May 27, 1955.

Franklin, M. C. (1955b)—"Topping-off beef cattle under Australian conditions". Roneoed report prepared for 19th Meeting Australian Committee on Animal Production. May 27, 1955.

Grant. A. B. (1954)—*Proc. N.Z. Soc. Anim. Prod.*, 14: 77.

Green, R. J. (1953)—*Aust. Vet. J.*, 29: 316.

Hewitt, A. C. T. (1953)—*J. Dep. Agric. Vict.*, 51: 289.

Muirhead, D. B. and Allden, W. G. (1952a)—*J. Dep. Agric. S. Aust.*, 55: 348.

Muirhead, D. B. and Allden, W. G. (1952b)—*J. Dep. Agric. S. Aust.*, 56: 211.

Pillinger, D. B. and Kelly, J. T. (1954)—*Tasm. J. Agric.*, 25: 5.

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LATE NEWS

The following news item which has just been received will be of interest to readers:—

New Degree Courses at the University of New England, N.S.W.

Two degree courses have been announced to commence in March, 1956 at the University of New England, Armidale, N.S.W.

The newly established *Faculty of Rural Science* will provide a four year course leading to the degree of *Bachelor of Rural Science*. The curriculum includes introductory training in Chemistry, Botany, Zoology and Physics with specialised courses in (a) Anatomy, Physiology, Nutrition, Breeding, Management and Health of Livestock. (b) Biochemistry and Microbiology. (c) Agronomy, Plant Physiology. Pastoral Botany and Pasture Management. (d) Agricultural Geology, Soil Science and Plant Nutrition and (e) Farm Economics and Management.

The *Faculty of Agricultural Economics*, which has also been recently established, will provide a four year course leading to the degree of *Bachelor of Agricultural Economics*. The curriculum will cover general tuition in Economics with specialised courses in Agricultural Economics, Farm Management, Rural Sociology, Statistics, Economics, History and other selected subjects.

Interested persons may obtain full information about the Faculties and Courses from the Registrar, University of New England, Armidale, New South Wales.

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These are wines made from the wine grower's own grapes grown on his Estates. Each wine bears its vintage year and each has its own pronounced regional character. All have won prizes at recent shows and are in the category of the great wines of Europe.

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Here, which is unique for Australia, the wines are stored in oak casks for a full two years before being laid down in bottles. Two great wines are now awaiting their time at Coonawarra—the 1954 and 1955 Vintages. The Vintages in bottle and available for sale are 1951, 1952 and 1953.

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The Modbury Estate undulates over the slopes of the Adelaide foothills only 14 miles North East of the city. The main varieties of grape cultivated are Rhine Riesling, Semillon, Hermitage and Palomino from which are produced the high quality white wines marketed under the brand name "Modbury Estate", comprising Hock, Chablis, Riesling, Moselle, Semillon (Sauternes).

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THE PRACTICAL ENTOMOLOGIST AND TAXONOMY

By C. E. CHADWICK

Insects form the largest group of animals and, in fact, about four-fifths of the total known species of animals are insects. They are man's most serious rival for supremacy on the earth and for this reason have come in for much study. Any insect, looked at from this viewpoint, comes in for review from two angles, firstly, what is it and secondly, what is to be done to prevent it from interfering with man's interests or at least to reduce the interference as much as possible?

Under the first heading we may look at insects from the viewpoint of classification or taxonomy, which is the field of work of the systematic entomologist or taxonomist. Secondly, we may see them from the viewpoint of the economic entomologist or pest control operator.

Any action either by economic entomologists or pest control operators must be preceded by an identification, of greater or less accuracy, by those who will perform the treatment. It must be expected that the economic entomologist will be more exacting in his requirements in identifications than the pest control operator but each must know what he is dealing with.

Torre-Bueno (1950) defines taxonomy as "the arranging of species and groups thereof into a system which shall exhibit their relationship to each other and their places in a natural classification." Horn (1929a) says "taxonomic work is synonymous with systematic work."

Problems Facing the Taxonomist

It is generally conceded that taxonomic work is somewhat exacting. For example, Muesebeck (1942), speaking of the increase in number of species of insects discovered, said "As the field has broadened there has been a corresponding, consistent development of specialisation in taxonomy until now even each of the major orders is considered too large and complex to enable a single worker to meet the increasingly exacting needs for identifications in any one of them." The United States Department of Agriculture has several specialists in each of the major orders: "Yet, even with that degree of specialization, only about two-thirds of the identifications made by the group as a whole during the past year were definite and complete."

There are several reasons for the difficulties experienced in taxonomic work. These include:—

1. *The enormous number of insect species.* Many and varied estimates have been made of the total number of species. Recent estimates vary from 625,000 to 900,000. Guesses at the total number of world species range from 2,500,000 to 10,000,000. These figures, of course, refer only to adults. "Now, when we consider that taxonomy implies the classification of insects in all stages of development, the immensity of the task ahead becomes even more appalling." (Muesebeck, 1942.)

2. *The historical method.* In the case of all insects it is essential, in matters of nomenclature, to go back to the original description even if it means going back to the 10th Edition of the *Systema Naturae* of Linnaeus (1758). The description of new species without adequate examination of the earliest literature may

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result in further synonyms. In other branches of entomology, e.g., insect control, the latest and best work can be accepted and all preceding work forgotten.

3. *The diversity of characters that must be used in separating various groups.* In the flies wing venation is very important in separating the various units, but the number of tarsal segments is of little consequence. In the beetles the position is precisely the reverse. In some groups one sex alone is identifiable, e.g., male Tachinids and male *Embioptera* alone can be identified with certainty; in termites the soldiers, and in ants the workers are the basis of identification from which keys are constructed. Thus specimens lacking the right caste or sex may be more or less useless. Among *Aleurodidae* the "pupae" alone are used for identification purposes. Sometimes differences between species may be very obvious, e.g., some bugs; in others differences between species were overlooked for many years, e.g., *Tribolium castaneum* and *T. confusum, Tenebrio molitor* and *T. obscura,* also several species of *Carpophilus.*

4. *Difficulty of obtaining literature.* Descriptions of insects may be widely scattered in the world's literature and may be in several languages. This difficulty is an important one so far as amateurs are concerned. In recent years some very good monographs of limited groups have appeared, but these merely represent a drop in the ocean.

5. *Scarcity of reliably identified specimens.* As a general rule these should be obtained from a specialist in the group, but in the case of common species this is not necessary.

6. *The margin for errors in determinations is infinitely less than in control work.* Such errors when detected are not hidden as part of a replicated experiment, and so a taxonomist is much more careful about committing himself. One might cite the advice of an experienced taxonomist, "Study a specimen until you are quite certain of your identification; then look again."

7. *"No systematist can make identifications quickly and definitely in any group until a large amount of background research has been done. . . .* One of the greatest needs in systematic entomology is that those to whom good systematic work is a basic need should do something to encourage and support the carrying on of such work, to recognise that research in systematic entomology is just as necessary as research in insecticides or physiology or life histories. It cannot be done without support." (Ferris, 1942.)

Where funds, equipment and technical assistance are concerned taxonomy is the Cinderella of entomological sciences. "This situation illustrates one of the most discouraging problems with which the systematist has to contend. That is the utterly trifling, the unspeakably piddling way in which we have to work." (Ferris (1942)).

8. "There are also the very difficult problems of placing in their correct categories *the physiological races of insects* which involve the so-called resistant strains in agricultural entomology and the biological races of insects met with in biological control work; tasks which the systematist has neither time, space nor equipment to undertake under present handicaps." (Essig, 1942.)

9. *Elementary enquiries.* Whilst people making enquiries of an elementary nature based on curiosity should be satisfied, the failure to cater for them properly is remarkable. The great bulk of these enquiries are of a popular and superficial nature and would be most satisfactorily answered by somebody with a real interest in acting as a liaison officer between the somewhat technical entomologist and the completely non-technical layman, i.e., the old-fashioned naturalist or even a journalist. As Oldroyd (1954) puts it: "More efficient use should be made of the existing taxonomists by relieving them

from routine identification work and using them for specialist consultation and the production of monographs and keys."

10. *Difficulty of getting taxonomic papers published,* particularly monographs and catalogues. Neither the *Bulletin of Entomological Research* nor the *Journal of Economic Entomology* will accept taxonomic papers unless they deal with species of economic importance. To my knowledge, completed catalogues of several groups of Australian insects still lie gathering dust, due to the inability of the authors to find funds for publication. The cost of publishing such monographs is so high that few have been published in Australia other than those of the C.S.I.R.O.

11. *Location of Types.* Many of the earlier workers in taxonomy deposited types abroad; fortunately pressure of opinion in Australia has reduced, although it has not entirely eliminated, this habit. Examination of type specimens may be essential in revisions of families or groups of insects.

12. *The International Commission of Zoological Nomenclature.* Mr. A. Musgrave, of the Australian Museum, has commented "The extraordinary rulings of the International Commission of Zoological Nomenclature may well be a reason for the lack of interest in taxonomy. These rulings, couched in ponderous legal phraseology, do little to simplify the position for the taxonomist."

Australian Taxonomic Workers

Australian taxonomists may be placed in the following three categories, based on the degree of specialisation of their work:—

1. *The part-time taxonomist.* This type of worker is primarily occupied with other work, but finds time to do a certain amount of work on one or more groups. Examples in this group include: E. H. Zeck on *Colydiidae, Droyopidae, Coccidae* and *Aphididae;* A. R. Brimblecombe on certain *Coccidae;* A. W. S. May on *Dacinae;* I. M. Mackerras on *Tabanidae;* N. B. Tindale on *Hepialidae* and other *Lepidoptera;* D. J. Lee and E. Reye on certain *Nematocera;* F. J. Gay on *Isoptera.* Also included in this category would be amateurs, for example, J. W. T. Armstrong on *Helodidae* and other *Coleoptera;* L. S. Couchman on *Rhopolocera;* Miss English on larval *Tabanidae;* and J. Burden on larvae of *Myrmeleontidae.*

2. *The general taxonomist and curator*: That is an entomologist devoting his full time to general curatorial work and studying in some special field. As examples we may quote A. Musgrave on bibliography and history of Australian entomology; A. N. Burns working on *Cicadidae* and *Rhopolocera;* and H. Womersley on *Acarina;* an entomologist appointed to a Department of Agriculture would come in this category.

3. The taxonomist covering a limited group or order. Iu Australia this type of taxonomist is at present, with one exception, confined to the C.S.I.R.O. Workers in this category include: I. F. B. Common having charge of *Lepidoptera,* and doing special work on *Tortricidae* and certain *Noctuidae;* S. J. Paramonov, in charge of *Diptera,* working on several families of that order; E. F. Riek, *Hymenoptera,* revising the *Chalcidoidea* and other groups; P. B. Carne in charge of *Coleoptera,* and interested in *Dynastinae* and larval Scarabs; K. H. L. Key, in charge of *Orthoptera,* particularly interested in *Acrididae;* A. W. Parrott, working privately, deals with *Braconidae* and *Ichneumonidae* only.

Of these three categories, only the first touches economic entomology and advises on control measures.

Comparison of Entomological Staffing of Australian Museums

There are, of course, places other than Museums where taxonomic work is carried on, but State Museums are the institutions most commonly consulted by a

person desiring to have insects identified. It is interesting to note that the staffing of the various Australian Museums is at present as follows:—

Queensland Museum (*Brisbane*). One lady graduate in charge of collections: "She has additional help as occasion demands."

Australian Museum (*Sydney*). A Curator of Insects, an Assistant Curator, and one technical assistant. It is proposed ultimately to increase this to three entomologists, two technical assistants, and a public relations officer to handle routine enquiries needing no real scientific knowledge.

National Museum (*Melbourne*). A Curator of Insects, an Assistant Curator, and a technical assistant.

Hobart Museum (*Hobart*). One entomologist, who was appointed recently.

South Australian Museum (*Adelaide*). An Entomologist, an Assistant Entomologist, two technical assistants and one honorary Acarologist. Another officer (employed in another capacity) takes a research interest in the collection of *Lepidoptera* in his own time.

Western Australian Museum (*Perth*). One Entomologist, who is assisted by the taxidermist when needed.

All these institutions maintain general collections. To maintain any size of general collection an entomologist and a technical assistant must be regarded as the *irreducible minimum*, except when the amount of work going on is exceedingly small.

Contributions of Taxonomists to Economic Entomology

Taxonomists have contributed much to economic entomology. The following may be quoted:—

1. Uvarov's Phase theory. ". . .it was Dr. Uvarov's study of the morphology of the thorax which caused him to recognise two forms occurring in *Locusta*, led him to enunciate the 'phase theory' of locust migration, and on that theory to develop our modern methods of locust control." (Albrecht, F. O., "The Anatomy of the Migratory Locust", foreword.)

2. Discrepancies between results of control experiments in insects in different countries may be because different, but closely related species, may be involved. Taxonomic investigations often supply the clue.

3. In biological control correct identifications are essential. For example, if a pest of oriental origin is mistakenly identified as a closely related European species, the search for natural enemies in Europe and their collection, rearing, and colonization for biological control might prove utterly futile and result in the loss of years of work and the useless expenditure of large sums of money. Clausen (1942) gives several examples illustrating the necessity for accurate taxonomic work in connection with the biological control, including the difficulties encountered with citrus scales in California.

4. The very obvious necessity for an economic entomologist to be certain of the insect with which he is working in order to record his results, to be able to repeat them on the same species if necessary, and to enable others to do likewise, hardly needs stressing. In extension and advisory work the economic entomologist must, first of all, identify the insect.

Le Pelley (1954) gives a good practical example of the reverse aspect: "Nearly all the major pests of Kenya were going under different names from those they had 25 years ago, and the former errors in identification had caused great delay in the establishment of control. This provided a concrete example for administrators of the economic value of taxonomic work."

Economic Entomology and Taxonomy

Although economic entomology and taxonomy should have a certain amount of overlap it must be conceded that basically they have very little in common. They might be best described as comple-

mentary. The same principles of nomenclature and classification go through all forms of systematic work in the biological sciences, whether they deal with entomology, zoology, botany, mycology or bacteriology. Systematic entomology probably has more in common with insect palaeontology and systematic serology than with other branches of entomology.

Economic entomology more or less assumes a knowledge of the identity of the insect (i.e., the name is merely a means to an end), from which literature is consulted, records are compiled, life histories are investigated and the effects of insecticides are studied. The affinities of economic entomology then, might be said to be with the agriculturist, the organic chemist or biochemist and perhaps the engineer if account is taken of equipment.

So far as the economic entomologist is concerned his main need for a taxonomist is to be supplied with a name for the insect in which he is interested. In order to obtain the identification he can assist the taxonomist by supplying him with data on locality from which the insect was obtained, its food plant or animal host and any data on habits, etc., as these facts often give a useful lead on the identity of the insect. The life history and bionomics of the insect thus supply a bridge between the two branches of the science—probably the only strong connecting link. Otherwise the two groups seek different purposes, using different principles, different literature, different techniques, different jargons and their main contacts are with totally different people. Some economic entomologists seem very disinclined to accept these fundamental differences.

Horn (1929b) said: "I believe that entomology has become split. Taxonomy is standing alone on the one side; the other branches on the other." Essig (1942) has a similar view: "Although the general scopes of systematic entomology and economic entomology overlap, it is important to note that in actual practice they seldom now actually unite and that there is a very distinct gap between them. . . . As I look back over the development of entomology during the brief period of thirty years, it appears to me that this gap has been widening at an alarming pace." The tendency of extremists among economic entomologists to concentrate attention on insecticides and to ignore bionomics is accentuating the gap between economic entomology and taxonomy.

So far as it goes we may follow Frison's definition (1942) of the scope of economic entomology as being "that it involves a broad concept including all kinds of insect control, coupled with general biological and ecological investigations." To that we must obviously add taxonomy as we must know what insects we are talking about. "Taxonomy is the focal point and basis for all the biological sciences." (Essig, 1942.)

The functions of an institution involved in economic entomology may be said to be threefold. In their logical order they are:—

1. Recognition of the insect pest (Taxonomy),
2. Knowledge of its life history, habits and host (Bionomics), and
3. Experiments on keeping the pest in check (Control).

In the case of a well-studied pest, the amount of time taken up under the three preceding headings would be in reverse order and of course economic institutions deal mainly with well-known pests. A well-balanced institution could be compared with a tripod having as its three legs pest control, bionomics and taxonomy, giving each its appropriate place.

The economic entomologist likewise has no need of the museum taxonomist if he is quite content to call insects grubs, bugs, beetles, etc., and if his only interest is to kill them. However, if the economic entomologist wants to make a scientific approach to his subject, accurate identification is essential. Is he

justified in expecting museums, universities and amateurs to be continually at his service if he does nothing worth-while himself? Is he entitled to call the tune without paying the piper? Ferris (1942), after discussing the need for proper provision for taxonomic workers expressed his opinion: "At this point I am going to lay down the law bluntly to the economic entomologists. If you have at times been disgusted with the inadequacies of our systematic work—if you feel that it should be done in such a fashion that it affords you the help that you need in your work—then it is up to you to do something about it. As long as you go on cadging systematic work from systematists like a pan-handler cadging dimes or cigar-butts, dimes and cigar-butts are all you are likely to get."

The responsibility of institutions concerned with economic entomology to do something to promote taxonomy for their own ends is slowly being recognised, for the leading Australian State in economic entomology has three of its entomologists working on the taxonomy of small groups of insects of economic importance and another one is one of a number of bodies subsidising research by another taxonomist studying two families of economic interest.

The Effect of New Insecticides on Research in Economic Entomology

The writings of a group of economic entomologists in a particular journal were examined over a period of 24 years; nine years before the war—the abnormal war period—nine years since the war, i.e., the era of the new insecticides. Taking as criteria (1) the article must be signed, (2) it must contain original matter and (3) it must not be less than a page in length, the figures shown in Table I were obtained:—

TABLE I.

Analyses of writings of a group of economic entomologists.

Topic	1931-1939 (9 years)	1940-1945 (6 years)	1946-1954 (9 years
Control	33	24	53
Control Plus Bionomics	8	5	8
Bionomics	24	1	1
Taxonomy	4	—	—

A more detailed examination of post-war figures gave the following results:—

Topic	1946	1947	1948	1949	1950	1951	1952	1953	1954
Control	14*	3	14*	6	5	6	1	3	1
Control Plus Bionomics	2	2	2	2	—	—	—	—	—
Bionomics	1	—	—	—	—	—	—	—	—
				Bedrock Erosion					
Taxonomy	—	—	—	—	—	—	—	—	—

*The large number of articles on control in 1946 and 1948 arose from experiments on DDT, i.e., routine testing.

These figures show a pronounced falling-off in papers on bionomics and taxonomy. Taylor (1943) refers to taxonomy as the bedrock of control. Likewise a knowledge of bionomics must be regarded as an obvious and elementary need. The bedrock has shown appreciable erosion in the case quoted. Essig (1942) says: "It is my contention that at no time can the essential foundational programme of any science be neglected if that science is to serve the nation to the fullest degree."

The increased efficiency of post-war insecticides may have encouraged some economic entomologists to avoid research in bionomics, which is less easy. This has given rise to an aberrant type of economic entomologist, perhaps best designated the insecticidal entomologist, who seems to have complete faith in the ability of the organic chemist to give him the wherewithal to solve all his control problems.

Much progress has been shown in improving methods of control since the war. This is primarily due to the development of a number of organic insecticides and to a lesser extent to the production of more efficient machinery to apply the insecticides. Who synthesized the insecticides? Who designed and built the machinery? Has the economic entomologist improved his knowledge of insect bionomics to a sufficient degree to enable him to make the best use of the work of the chemist and the engineer? Also we may ask how much of the credit for improved control of insects can the economic entomologist honestly claim as his due?

It is obvious that before the chemist will release his product he must have synthesized it and then tested it out on insects. In other words, the real research has been done by the chemist before the economic entomologist came into possession of the product. The entomologist then tests it in the field. Testing of this type has been going on in scores of countries and thousands of experiments have been carried out. Can this type of routine work (still) be called research?

Routine testing of the new insecticides has been proceeding rather intensively for the last ten years, but we still have plenty of pest species and new minor pests are recorded every year. Will the attack on the well-known pests and the reduction (if any) in their numbers merely clear the way for resistant strains or other pests which are better adapted to the new conditions? Kuenen (1952) comments: "Each time an insecticide is applied a certain number of animals are killed, which changes the genetical composition of the population. In many cases the results have not become evident yet, but where the development of resistant strains has occurred, this shows us what we can expect if this goes on much longer. The fact that the animal organism can adapt itself to this very unnatural change in the environment, such as the addition of DDT, lead arsenate, hydrogen cyanide or some other insecticide, gives us perhaps the most striking example of what unknown resources insects have in store. The warning should not be taken too lightly. Our very existence is to an ever-increasing degree dependent upon the successful control of insects, and at present chemicals constitute the mainstay of the system. A different approach, taking into account the more fundamental knowledge as a basis, may in future stave off the approaching catastrophe in agriculture."

In this connection one comment of Chiang and Cutkomp (1953), after investigations on the European corn borer, is of interest: "Certain of the biological characteristics of the corn borer make it unlikely that improvements in the insecticidal control of this pest is to be found by searching merely for a more toxic material."

Now and again we hear of insecticides which are hailed as "the answer" to a certain insect, but the impudent Arth-

ropod answers back, in some cases at least, by the production of a resistant strain.

Busvine (1954), after pointing out that not a great number of insects had developed resistance, continues: "In the field of medical entomology we feel considerable anxiety about the possibility that resistant strains may win back for disease the new conquests that we have made in recent years by the use of insecticides. No doubt, there is a similar threat in the agricultural field."

It is possible that the economic entomologist is under-rating the insect's powers of resistance to insecticides and is neglecting the study of bionomics, which might give him more effective results.

Future Lines of Research

Since the War there have been some surprising changes in the knowledge of the taxonomy of common insects. The common armyworm is not *Cirphis unipuncta* as was thought for many years, but an entirely new genus and species *Pseudaletia australis;* there are two species of leaf-blister saw-fly, not one; there are two species of *Heliothis,* not one, with interesting distributions, and so on. It is a reasonable guess to say that there will be changes in status of many more of our common insect names, and that attention to these will correct some unsuspected errors.

From the economic entomologist's point of view there is a need for descriptions and especially for adequate illustrations of many insect larvae which are pests, e.g., white curl grubs, cutworms, numerous caterpillars which attack plants (e.g., *Pyralidae, Noctuidae,* etc.). Such diagrams and descriptions need to be made available to all who are likely to need them, not restricted to specimens in a tube, nor carried in the mind of one man, for with his departure the very great bulk, at least, of the information is lost.

The taxonomy of numerous groups of economic *Coleoptera* need attention, e.g., there are considerably more than 3,000 weevils, over 1,900 leaf-eating beetles (Chrysomelidae); many families of *Hemiptera, Lepidoptera* and *Diptera* need attention; the great bulk of these have not been studied for many years.

Only if the University trained entomologist can get to work on these, as well as his other problems with a minimum of interruption to deal with trivial matters, is any real progress to be made.

And so far as the economic entomologist has dealings with taxonomy we may conclude by quoting Frison (1942) "Economic entomology has a real and serious responsibility from the standpoint of its own selfish needs in guaranteeing that its reciprocal partner, taxonomy, has the opportunity and funds to function as it should." What constructive action is economic entomology taking to assist in this way?

References

Busvine, J. R. (1954).—The development of resistance to insecticides. Rep. Sixth Common. Ent. Conf., July, 1954, 60-65.

Chiang, H. C., and Cutkomp, L. K., (1953).—The importance of some biological characteristics of European corn borer on timing of application of insecticides. *J. Econ. Ent.* 46: (2), April, 277-287.

Clausen, C. P. (1942).—The relation of taxonomy to biological control. *J. Econ. Ent.*, 35: (5), October, 744-748.

Essig, E. O., (1942).—The significance of taxonomy in the general field of economic entomology. *J. Econ. Ent.* 35: (5), October, 739-743.

Ferris, G. F. (1942).—The needs of systematic entomology. *J. Econ. Ent.* 35: (5), October, 732-738.

Frison, T. H., (1942).—The significance of economic entomology in the field of insect taxonomy. *J. Econ. Ent.* 35: (5), October, 749-752.

Horn, W. (1929a).—The future of insect taxonomy. Fourth Int. Congr. Ent., Ithaca, Vol. II, 34-51.

Horn, W. (1929b)—On the splitting influence of the increase of entomological knowledge and on the enigma of species. Fourth Int. Congr. Ent., Ithaca, Vol. II (Trans.), 500-507.

Kuenen, D. J. (1952)—Address by the President of the Congress. Trans. Ninth Int. Congr. Ent., Amsterdam, I, XLVIII-LIV.

Le Pelley, R. H. (1954)—Discussion on the supply and training of taxonomists. Rep. Sixth Comm. Ent. Conf., July, 69-74.

Muesebeck, C. F. W. (1942)—Fundamental taxonomic problems in quarantine and nursery inspection. *J. Econ. Ent.* 35: (5), October, 753-758.

Oldroyd, H. (1954)—Discussion on the supply and training of taxonomists. Rep. Sixth Comm. Ent. Conf., July, 1954, 69-74.

Taylor, F. H. (1943)—Presidential Address: Some aspects of the control of disease-carrying insects. Proc. Linn. Soc. N.S.W., LXVIII, (1-2), i-x.

Torre-Bueno, J. R. de la (1950)—A Glossary of Entomology.

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BOOK REVIEWS

GRAIN CROPS

By HAROLD K. WILSON

(*N. Y. McGraw-Hill Book Company*, 1955, *pp. viii* + 396, $6.50)

The second edition of Professor Wilson's book follows the same general lines as the first, which was published seven years ago. The book has been revised to bring production statistics up to date, and to include new information and a number of recent literature references. For instance, the chapter on weeds has been expanded to include information concerning hormone type herbicides, together with a table of recommendations for their use.

The book is planned primarily as a text book for use in agricultural courses at universities in the U.S.A., and deals primarily with American information and references. The first nine chapters of the book deal with general aspects of crops, such as plant classification, crop rotation, diseases, weeds and pests. The next thirteen chapters discuss individual crops, including wheat, rye, oats, barley, linseed, rice, buckwheat, millets, soybeans, maize and sorghum, while the last two chapters are concerned with marketing and the improvement of grain crops.

Comments on wheat quality, although brief, are of interest in view of the present discussions in Australia on the improvement of the protein content of wheat. The importance of environment and soil factors are indicated. The prairie soils are well suited to the production of high quality wheat, because these soils were inherently rich in nitrogen and other nutrients. Results of a Minnesota trial are quoted, in which the wheat following sweet clover contained 13.6 per cent. of protein, while that following a non-legume contained 12.4 per cent.

The book is well produced and illustrated, although the key map showing the distribution of the great soil groups in the U.S.A. is difficult to read. Rates of seedings of several crops are expressed in pecks (¼ bushel), an old English dry measure not now used in Australia. The book contains much of interest to Australian agronomists, and should serve as a useful reference book on grain crops.

H. J. SIMS.

A SYSTEM FOR THE DESCRIPTION OF SOIL STRUCTURE AND CONSISTENCE IN THE FIELD

By B. E. BUTLER

Summary

A system for the field description of soil structure and consistence is outlined. In the description of structure it follows fairly closely the traditional approach, though there is a more definite integration of the concept of the *ped*. An attempt has also been made to separate clearly the parameters of soil structure—grade, shape, and size. Consideration is also given to the breakdown of primary structural units. The system makes a new approach to the description of consistence. This is based on an assessment of the yield-point, and on the effect of a small, prescribed amount of work done on a piece of the soil material. To evaluate the effect of the work done, two concepts, coalescence and pulverescence, are introduced. The consistence parameters of a number of soil materials are discussed in relation to moisture status and texture.

Introduction

In scientific work one of the purposes of descriptive method is to effect a preliminary segregation of the data which will facilitate quantitative studies. In soil survey work in New South Wales it has been apparent for some years that the existing descriptive systems for soil structure and consistence (Templin et al. 1945; Anon 1948, U.S.D.A. 1951) did not serve this purpose adequately. In many instances differences were apparent between soil materials which these systems could not distinguish. Since 1945 soil surveyors in the region have adopted a series of changes in their descriptive methods, and these have finally culminated in a system which seems sufficiently distinct to justify publication. The system has been in regular use by four or five soil surveyors for several years now, and some confidence can be entertained that it is both usable and broad enough in scope to cover the range of soil conditions likely to be encountered.

The description of the physical conditions of soil materials in the field is mainly subdivided under the three headings of texture, structure and consistence. A comprehensive description should include other features also, as indicated by Smith & Cernuda (1952), but these will not be elaborated in this report. Texture, in the field, refers to the physical characteristics of the material when it is kneaded into a homogeneous state. Consistence on the other hand refers to its physical characteristics without preliminary kneading. Structure refers to form and orderliness in a mass of soil.

The system of structure and consistence description has been embodied in a code to assist recording, and this will be presented *pari passu*.

Preliminary Considerations

Peds

The scope of the term *soil structure* is quite wide (Zakharov 1927, Yoder 1937, Russell 1938, and Nikiforoff 1941). The soil surveyor's or soil morphologist's use of the term has a restricted significance and follows in the tradition set by Zakharov (1927) who defined soil structure as "the very fragments or clods into which the soil breaks up". The breaking of a mass of soil, the size, shape and orientation of the pieces are the essential considerations in this context. The concept of the *ped* (U.S.D.A. 1951, p.225) develops these ideas further, and it is adopted as a central idea in this report.

When a mass of soil material is broken down it may happen that the resulting pieces are all of one particular size and shape. When such a characteristic population of pieces occur they are called peds, and defined in terms of size, shape and orientation. The actual size and shape of peds from different soil materials

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may differ widely, though peds from the one soil material are uniform.* In contrast to peds, a soil material may break into *fragments* which have no uniform size and shape, or into its ultimate particles. Soil materials do occur having the property of breaking down entirely to peds, in fact some are in this form even without any preliminary breaking. In many soil materials, however, the result of breaking is that, whilst a proportion of the material occurs as peds, some considerable proportion of it consists of fragments and ultimate particles. The proportion of peds depends on both the tendency of the soil material to form peds, and also on the amount of work done on the soil mass. With increasing amounts of work done on a soil mass several successive populations of peds may be produced, each smaller than the preceding one; and sooner or later an increasing proportion of fragments and ultimate particles appear. In the final case all soil materials would be reduced to their ultimate particles, and any differences due to a special arrangement of particles would be obliterated.

A few words may be added about the breaking of materials. A material which has a uniform force of cohesion throughout its mass will break into such pieces and in such a manner depending solely on the way in which it is stressed. The predisposition of certain soil materials to break into peds clearly indicates that the force of cohesion in the mass is *not* uniform. Moreover, there must be an orderly variation in the force of cohesion and this orderly variation may be different along the different axes. Furthermore, the fact that some soil materials will break down into successive populations of peds of smaller and smaller size as more work is done on them, indicates that the pattern of cohesion may be not only orderly but complex too, and may be likened in graphical representation to a wave-on-wave arrangement. This complex variation in the cohesion factor may pass through the macro-scale, where it is expressed by visible peds, well across into the micro-scale where its final expression will be determined by the size of the ultimate soil particles. Its expression in the micro-scale should be sought in its influence on the cohesive properties of the material. A datum for comparison here would be the cohesive properties of the same material when any specific orderliness (it may be called fabric) has been destroyed by kneading or other work done.

There is a clear basis for distinguishing those soil materials which break down to form peds — *pedal** soil materials, from the non-pedal or *apedal** soil materials; and this is whether or not the pieces into which it breaks have some characteristic size and shape, or if the sizes and shapes depend solely on the manner in which it is stressed during the examination. It may be mentioned here that some soil materials are pedal in the larger sizes but apedal if broken finer, e.g., some of the coarser B horizons of solodised solonetzs. On the other hand the lower horizons of krasnozems are usually apedal in the larger sizes, though with well-developed peds in the $\frac{1}{4}$ and $\frac{1}{8}$ inch range.

Consistence

The consistence of a soil material is the strength and kind of cohesion manifest in it. The strength of cohesion can be determined as the magnitude of the force needed to cause disruption or distortion. The *kind* of cohesion is determined in this present system by the characteristics which develop in the material when a certain amount of work is done on it. The kind of cohesion in the soil material *before* any work is done on it is the specific information sought, so the amount of work done is selected

*It seems reasonable that simple multiples in size and shape may be credited as peds.

*It seems more consistent to use the terms pedal and apedal for structured and structureless respectively since the terms refer specifically to the criterion by which they are determined. Moreover the introduction of the term apedal avoids the contradiction of stating that the structure of a given soil is "structureless".

as the minimum needed to give a reaction.

Scale of Forces

In the assessment of consistence. and to a lesser extent in assessing structure, it is necessary to be able to refer to the magnitude of force, specifically the force needed to overcome cohesion in the soil material. For a field descriptive procedure the method so far adopted has been the standardisation of the force exerted in manipulating a piece of soil in the hand. Since the strength of a piece of soil varies with the size of the piece, the forces listed below refer specifically to a ped or fragment about $\frac{3}{4}$ inch size. Where smaller pieces must be used, allowance must be made on the basis of the size-strength relationship (Marshall & Quirk 1950). The manipulation involves a compressive shear force exerted between thumb and fingers, and the force nominated is that which is just sufficient to cause breaking or bending. The scale of forces is:—

(1) Force 1—a very small, almost nil, force. Code 1. Sometimes it is convenient to employ force zero to indicate actual separateness, as in loose sands.
(2) Force 2—a small, but significant, force. Code 2.
(3) Force 3—a moderate force. Code 3.
(4) Force 4—a strong force, but conveniently within the power of thumb and fingers. Code 4.
(5) Force 5—a very strong force, at and passing beyond the capability of thumb and fingers. Code 5.

This scale of forces is used, without variation, for any determination referring to structure or consistence.

Scale of Moistness

Each description of consistence is referred to a moisture stage of the soil material. Experience indicates that soil structure, too, especially structure grade, varies with moistness. For field description the moistness scale of Canada (Anon 1948) has been adapted here. A modification has been made by subdividing each moisture stage into three*. The moisture scale is specified as follows:—

(1) Dry—the material becomes darker, or assumes a lower colour value (Munsel notation) when moisture is added. Code D, and subdivided into D_1, D_2 and D_3; D_1 being driest, and D_3 contiguous to the moderately moist stage.
(2) Moderately moist, the material is not dry and it is not moist or wet. Code MM, and subdivided into MM_1, MM_2, and MM_3; the lastnamed being contiguous to the moist stage.
(3) Moist—the material is capable of being rolled between thumb and fingers into homogeneous rods not more than $\frac{1}{8}$" diameter and at least $\frac{1}{2}$" long. Code M and subdivided into M_1, M_2 and M_3; the lastnamed being contiguous to the wet stage. The magnitude of the force needed and the time taken to mould the rod is irrelevant.
(4) Wet—the material will wet and/or stick to the fingers when moulded. Code W, and subdivided into W_1, W_2 and W_3; the lastnamed being wet-test.

It will be apparent that non-coherent materials such as sands and silts cannot conform to the "moist" specification. Local practice is usually to place such materials in this range by judgment, however, the alternative course of not referring them to the moist range at all would not cause serious misunderstanding.

From field observation it seems that the wilting point of a soil is MM_3 and field capacity is M_3. Air dryness is D_1, D_2 or D_3 depending on the atmospheric

*This subdivision of each moisture stage has been criticised in Australia as unreal and unreplicable; however, soil surveyors who regularly use this system prefer its retention. The threefold subdivision accommodates the degrees of perfection with which the individual example matches the specifications. For example, the moist stage requires that the material should be mouldable into rods $\frac{1}{8}$" diameter and at least $\frac{1}{2}$" long; the "moist 1" material will just do this; the "moist 2" material fills these specifications liberally; and the "moist 3" material is similar but in addition it tends to be sticky.

humidity. However, these indications have not yet been confirmed, neither is it known whether the moisture stages can be correlated with pF values or with per cent. moisture content.

Structure

The points to be evaluated in the structure description are:—

(1) The grade of structure, or the completeness with which the soil mass occurs as, or will break into peds.
(2) The shape of the peds and their orientation.
(3) The size of the peds.
(4) The breakdown of the primary peds to secondary peds—when applicable.

The descriptive system and the code presented here follows generally that proposed by Hubble (1948).

Grade of Structure

This is the readiness and completeness with which a mass of soil material will break down into peds (U.S.D.A. 1951, p.220). It is the difference between inter- and intra-aggregate cohesion (Nikiforoff 1941). There is little prospect of measuring these forces adequately in the field, and the course adopted in this system is simply to drop a spadeful of undisturbed soil material from a sufficient height to cause disruption. The structure grade is assessed as follows:—

(1) Apedal—none of the material occurs in the form of peds; it consists wholly of fragments and/or ultimate particles. Code A.
(2) Weak—up to one-third of the material consists of peds, the remainder of fragments of disorganised shapes and sizes or of ultimate particles. Code I.
(3) Moderate—between one-third and four-fifths of the material consists of peds. Code II.
(4) Strong or high—over four-fifths of the material consists of peds. Code III.

Shape and Orientation of Peds

The earlier naming of structure forms as "granular", "nutty" (e.g., Northcote et al. 1954, p.17) and other naturalistic forms is unfortunate for clarity since each is likely to involve both size and shape connotations, besides being vague on what is the naturalistic form intended, e.g., what *nut* nutty refers to. It is more desirable to entirely separate size and shape considerations, and refer all shapes to geometric forms which allow of no variations of individual interpretation. Under these circumstances no special definitions are called for. The following terms have been used locally:—

(1) Blocky or cubic, referring to the form of a cube. Subdivided into angular blocky (code ABL) and subangular blocky (code SABL) according to the sharpness of the corners.
(2) Prismatic: referring to the form of a prism with the longer axis in the vertical plane. Subdivided into angular prismatic (code APR) and subangular prismatic (SAPR) according to the angularity of the vertical edges. The nature of the top of the prism, whether domed, flat or pointed, may be added as a postscript.
(3) Polyhedral: referring to the shape of those polyhedrons having more than six sides. Code PH. Only forms with sharp corners are known to occur.
(4) Parallelepipedal: referring to the shape of the parellelepiped or solid skewed-paralellogram. Code PLL.
(5) Platy: referring to a solid form with horizontal faces well developed and vertical faces ill-defined and of a smaller dimension. Code PL.
(6) Spheroidal: referring to the form of a sphere. Subdivided into a solid sphere (code SSPH) and a sphere with visible voids (code VSPH).

Size of Peds.

This is given simply in inches and fractions thereof. For geometric forms

having unequal dimensions, such as the prism, both dimensions are given, e.g., APR 1″ x 3″. In using the code the size specifications must always be followed by the inch abbreviation (″) or the figures may be confused with force values.

Breakdown of Primary Peds

The usual description of structure refers to the largest peds which the soil material can produce. But in many soil materials these primary peds will break down readily to a second population of smaller peds, and these may be of a different form from the primary peds. This property of a soil material is worth including in a description, and as the primary peds can frequently be manipulated in the hand, some estimate of the force involved in the breakdown can be given.

Examples of the Code for Structure

The accepted form for the code is:—

III (ABL2″)

with the structure grade placed first, and in parenthesis the ped form followed by the dimension of the ped. In the case of apedal materials the code "A" completes the statement as far as structure is concerned; the following consistence description will provide all further information needed. Where the breakdown of peds is described it follows the normal structure statement, preceded by the relevant force designations, viz.:—

III (APR 3″ x 8″), 1, ABL ½″, 2, ABL ¼″

Consistence

As mentioned above the points to be evaluated in describing the consistence of a soil material are the strength of cohesion and the reaction to a minimal amount of work done. The procedure adopted is to take a piece of undisturbed soil material of about ¾″ size and, holding it between thumb and fingers, apply a compressive-shearing force of just sufficient magnitude to cause the piece to deform or break. This force is expressed in the scale of forces set out above, and it is the first value sought for the consistence description.

The work to be done on the soil material to obtain the second value is the application of this same force by a rotary movement of thumb and fingers for two seconds. It will be seen that the amount of work to be done is not the same for all soils; it is adjusted to the cohesive strength of each sample, and is the minimum amount that will give a reaction (bending or breaking) during the two seconds of application. When work is done on soil materials the result may be either to break them down to smaller and smaller pieces until finally the ultimate soil particles are separated, or alternatively, the final result may be a coherent, plastic mass. In the latter case the material may have the plastic property at the commencement of working, or it may only appear after passing through a friable state. These manifestations are the bases of the descriptive system, and their expression is vested in the concepts and scales of *pulverescence* and *coalescence*.

Pulverescence

The consideration of pulverescence is applicable to soil materials which break into smaller and smaller pieces as a result of work being done on them. The significant characteristic is the manner of breaking, whether into a population of peds, or into an unsorted assembly of fragments and/or ultimate soil particles. The introduction of the ped concept into consistency considerations has been mentioned earlier in this paper. The occurrence of peds on the microscale has a strong influence on the force of cohesion. A mass of soil material which is strongly pedal has a much lower cohesion than a mass of soil of the same texture which is apedal.

The soil material which does not break into peds will break into fragments and/or ultimate particles. This material, not being predisposed to break into pieces of any particular size and shape, must be bonded uniformly. It would seem to follow that whether it breaks down to frag-

ments in one case, or to ultimate particles in another, there is no essential difference in the kind of cohesion, but only in the effectiveness of the applied work. It is concluded from this argument that there is no justification for distinguishing the fragments from the ultimate particles in assessing pulverescence.*

A scale of pulverescence has been adopted which depends on the amount of peds in relation to fragments and/or ultimate particles in the hand sample after it has worked as defined above:—

Pulverescence 1: less than one-tenth of the material occurs in the form of irregular fragments and/or ultimate particles. Code P1. Pulverescence zero may be used if the material consists entirely of peds.

Pulverescence 2: between one-tenth and one-third of the material occurs as fragments and particles. Code P2.

Pulverescence 3: between one-third and two-thirds of the material occurs as fragments and particles. Code P3.

Pulverescence 4: between two-thirds and nine-tenths of the material occurs as fragments and particles. Code P4.

Pulverescence 5: more than nine-tenths of the material occurs as fragments and particles. Code P5.

Coalescence

The consideration of coalescence is applicable to soil materials which have plastic properties or else develop plastic properties as a result of work being done on them. The essential aspect of the plastic state is that the material deforms or bends, as distinct from breaking. The ideal plastic material bends without any associated breaking, but very rarely is this state found in undisturbed soil materials: they usually require that work be done on them before this state is developed. In soil materials there is more or less of breaking and crumbling, and, as work is continued, the material then coalesces into the plastic state.

A scale of coalescence has been adopted which depends on the proportion of the hand sample which has coalesced into the plastic form after work has been done on it as defined above. The amount of initial breaking is also taken into account.

Coalescence 1: less than one-tenth of the material occurs as plastic rods or balls. Code. C1. Coalescence zero may be used for material giving no coalesced portion.

Coalescence 2: from one-tenth to a half of the material occurs in the form of plastic balls. Code C2.

Coalescence 3: from one-half to nine-tenths of the material occurs in the form of plastic balls. Code 3.

For C1, C2 and C3 there is always a clear development of the friable state during working, and this is followed by a variable amount of coalescence by the time working stops. For C4, C5 and C6 there is no significant amount of un-coalesced material at the completion of working, and the differentiating factor is the amount of preliminary fracture which occurs.

Coalescence 4: more than nine-tenths of the material occurs in the coalesced form, and subdivision of the primary pieces results from work. Code C.4

Coalescence 5: all of the material occurs in the coalesced form and there is no subdivision of the primary piece, but some fracturing can be seen at the commencement of working. Code C5.

Coalescence 6: as for C5 but there is no preliminary fracturing to be seen. Code C6.

Soil materials with a high coalescence are very prone to change to the coalesced form when handled. Their reaction to the soil auger or spade during removal of the sample should be carefully noted and the piece selected for description taken only from the uncoalesced portion.

*Some field workers prefer to consider them separately, confining the term pulverescence for the tendency to go to ultimate particles, and using "fragmentariness" for the tendency to go to fragments.

General Descriptive Terms for Consistence

A statement of the appropriate pulverescence and/or coalescence values will specifically describe the soil material, but there is some use for more general, descriptive terms. Those adopted, and their specifications, are shown in Figure 1. The words crumbly (code CR), brittle (code BR), labile (code LA) and plastic (code PL) are each used with a special meaning, which is not, however, in conflict with their meaning as given in the Oxford Dictionary.

The Full Statement of Consistence

It is proposed that the full statement of soil consistence should include the following:—

(1) Moisture stage.
(2) The force of cohesion (yield point) of the $\frac{3}{4}$" piece.
(3) The general descriptive term of consistence.
(4) The size of the smallest peds to be seen during working.
(5) Statement of pulverescence and coalescence.

The proposed form for writing the code is

M2 (2 LA,$\frac{1}{32}$") P2, C3

with the first term being the moisture stage, the first inside the parenthesis the yield point, the second the general descriptive term of consistence, the third the smallest size of ped, and after the parenthesis first the pulverescence value and then the coalescence value.

Discussion

The method set out above is intended merely to describe soil materials; the measurements involved are not sufficiently rigorous for the examination to amount to an analysis in the scientific sense. Its chief value is that it involves a closer and more detailed examination of the soil than is usually given, and it provides a language and a system for talking about some of the physical properties of soils. It is in this light that the diagrams in the later part of this paper should be read.

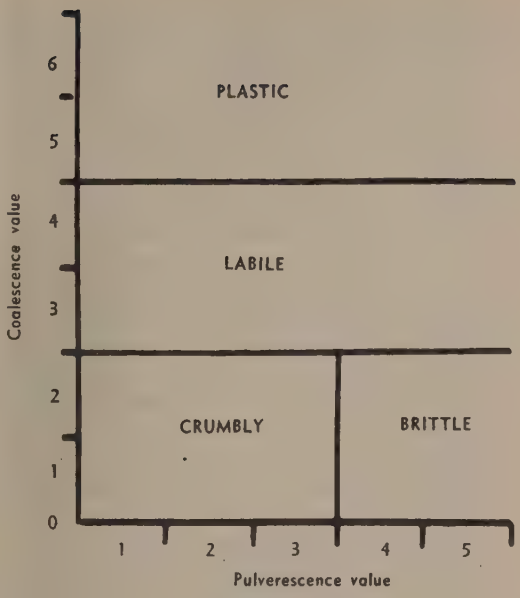

Figure 1.
Showing the general consistence categories in terms of pulverescence and coalescence.

The Force 5 and Beyond

Materials with a cohesive force of 5 or more need some comment. The assessment of forces beyond 5 has not been allowed for in this system, and some expedient such as striking with a hammer (U.S.D.A. 1951, p.234) may be resorted to. In actual fact soil materials, other than stones concretions and hardpans, rarely suggest the need for a force greatly in excess of 5 if the $\frac{3}{4}$" lump specification is adhered to. But even so it is sometimes difficult to determine the kind of consistence for these materials and they can be merely described as "5", e.g., D1(5). Since consistence descriptions for several moisture stages are needed to characterise a soil material, the moister consistence descriptions will help to throw light on the significance of the drier one.

Cemented and Sticky Consistence

The omission of cemented and sticky consistences from the present system may require some comment. In regard to cemented consistences, their chief

feature, apart from high forces of cohesion, is that the kind and magnitude of cohesion varies very little or not at all with changes of moistness. Since the descriptive system as proposed above can convey these features it has not seemed necessary to create a special category for them.

The need for consideration of sticky consistences has not emerged in the region where this consistency descriptive system was developed. It seems that stickiness over and above that due to mere wetness is confined to coalesced materials, and as the description applies to soil materials before coalescence, attention has not been given to it. Nevertheless it may be a useful criterion for distinguishing one soil material from another, and its incorporation in a descriptive system thereby vindicated. The case may be met by adopting the standards of stickiness—slightly sticky, sticky and very sticky—defined in the Soil Survey Manual (U.S.D.A. 1951, p.232).

Consistence in Relation to Texture

The greatest significance of consistence properties is gained by considering them in relation to texture. Each texture class has a "normal" range of consistence properties, with the properties changing according to the moistness of the sample. For example a "normal" heavy clay has a cohesion of force 5 when dry, and this falls to about 3½ or 4 in the moist stage; at about moderately moist 2, plastic properties begin to appear and these increase to coalescence 5 at moist 3. However there is a great diversity of consistence properties of clays, and it may be said that, for clays, these vary all the way to those of sands. The range of consistence properties is less for clay-loams than for clays, and for loams less than for clay-loams. Sands alone have a very narrow range of consistence properties. In the ensuing discussion it will be most illuminating therefore to give particular attention to clays, though the same principles apply to lesser degrees, to the less clayey textures.

Texture of soil materials, as determined in the field, is based on consistence properties of the material when kneaded for 20 seconds or so between thumb and fingers at a specific moisture stage (usually M3). According to the cohesion and plasticity of the material under these conditions, and the "feel" of the coarser grain sizes, it is classified as clay, loam, sand, etc. But *before* being kneaded the cohesion, plasticity, etc. (i.e., the consistence) of the material may be quite otherwise; and it is the change in properties which kneading may make which is the basis of the distinction between texture and consistence. In some soil materials kneading, or doing work on it, causes no change in properties, whilst in other materials it causes a profound change. These data may be related to the discussion under the heading of peds at the beginning of this paper. Soil materials may have a specific organisation in the arrangement of their particles, and this expresses itself as modifications of the consistence properties as more and more work is done on them. In this paper the examples of the "normal" texture class are those which show minimal consistency changes as work is done on them.

In some soil materials there are not only consistency differences between the hand sample as kneaded in texturing, compared with the consistence as determined above, but there is also a progressive change as manipulation is continued for a long period up to 15 minutes. This indicates a fabric, or specific organisation of particles, of considerable stability and probably also of complexity.

The "light" heavy clays of Taylor & Hooper (1938, p.70-75) and the "friable" clays of Butler et al. (1942, p.37) are examples of clays which have consistence properties greatly at variance from those of the "normal" clays. These clays have the consistence properties of gravels,

sands or loams; indeed the farmers refer to them as gravels and in their influence on drainage they seem to behave as gravels. During the manipulation of field texturing their apparent clayiness increases progressively until, at the end of five minutes, it fully corroborates the mechanical analysis figures (*vide loc. cit.*) for heavy clay. Less striking examples of the discrepancies between consistence and texture are common, and the usefulness of consistency studies in following these changes with respect to moisture stage is brought out in Figures 2, 3 and 4.

The soil materials which have consistency properties suggesting less clay than they actually contain are designated as "sub-plastic". In contrast to these are the "super-plastic" clays which show diminishing apparent clayiness as manipulation is continued. Local experience to date associates super-plastic soil materials with old, buried soils, which seem to have much in common with gumbotil (Hseung et al, 1949), however the association may not be exclusive. A useful expedient for assessing these super and sub-plastic materials in the field is to quote two textures, one for the first apparent texture and the second for the final texture after manipulation has been continued to the point where no change occurs. During this process more water will need to be added to maintain the moisture stage at M3 as the breakdown of the fabric has the effect of drying out the sample. However, this method of assessment is known to be unreliable as the 'first" texture is influenced by the moisture stage at the time texturing is commenced.

Figure 2 illustrates the changes in the force of cohesion of a number of heavy clays as work is done on them. This data is based on soil materials which are at moisture stage M3 and kept at that moistness throughout the trial by the addition of more water as needed. The work done is manipulation between thumb and fingers.

Figure 3 shows the variation in the force of cohesion of various soil materials throughout the moisture range. It will be noticed that there is a general tendency for cohesion to decrease with increasing moistness except in the cemented materials. Though cohesion increases with clay content—as indicated by the graphs for "sand", "normal clay-loam" and "normal clay", individual clays may occur in almost any situation. Thus the self-mulching clay could barely be dis-

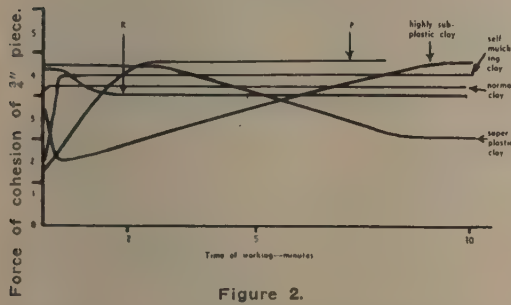

Figure 2.

Changes in the force of cohesion as work is done on several clay materials. The work done is manipulation between thumb and fingers, with the moisture stage maintained at M3 throughout the test. The "self-mulching clay" is the A horizon of Yooroobla clay (Churchward and Flint, in press); the "normal clay" is the B horizon of Mundiwa loam (Smith, 1945), the "highly sub-plastic clay" is the C horizon of Merungle loam (Taylor and Hooper, 1938) and the "super-plastic clay" is a Katandra clay (unpublished data). Clays P and R represent lesser degrees of sub-plasticity and super-plasticity respectively.

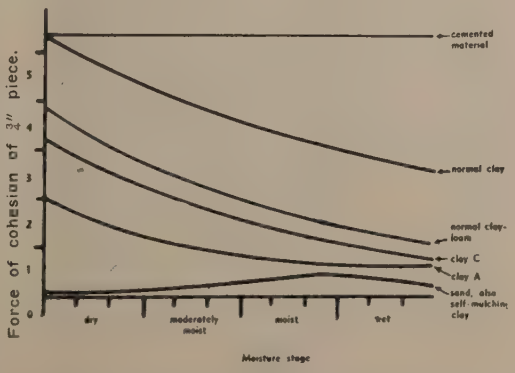

Figure 3.

Showing variations in the force of cohesion of different soil materials throughout the moisture range. "Normal clay" is the B horizon of Mundiwa loam (Smith, 1945), "normal clay-loam" is the A horizon of Muckatah clay-loam (Smith, 1945), "self mulching clay" is the A horizon of Yooroobla clay (Churchward and Flint, in press).

tinguished from a sand—unless it was coalesced (see Figure 2). Other deviations from the "normal clay" are indicated by clays A and C.

Figure 4 shows the diversity of plastic properties of different clays with changes of moistness. Coalescence value is taken as a measure of plasticity. The curve for "normal clay" may be compared with a self-mulching clay, and with a highly sub-plastic clay. Clays D and E show intermediate degrees of sub-plasticity. It will be noted that not only the magnitude of the plasticity value, but also the shape of the curve, is quite variable among different clays. This makes it impossible to select any one moisture stage for characterising the plastic properties of soil materials.

Figure 5 shows the variations in pulverescence values of a selection of soil materials with changes in moisture content. There seems to be no general or "normal" relationship between pulverescence value and texture, except that the very sandy textures always have a high value. The pulverescence value would bear an inverse relationship to what the field agronomist would call fineness of tilth as produced by tillage. However this statement would not apply to sands which may be regarded as giving a high grade of tilth though they would not have a low pulverescence value. Generally the pulverescence value falls with increasing moistness up to field capacity, then it increases rapidly again. In this moisture stage the pulverised material immediately coalesces. These data are all relevant to the characterisation of the soil material, and to the agronomist's selection of the best moisture stage for tillage. Soils A and B in Figure 5 present these characteristics. Soil D, the A horizon of a humic gley soil, contrasts with these in having a uniformly low pulverescence at all moisture stages. Soil E, the A horizon of Riverina clay (Johnston, 1953), a solodised solentz, has a uniformly high pulverescence at all moisture stages. Soil E, a self-mulching clay, does not show the initial decline in pulverescence value, but, beyond moist 2, a remarkable increase.

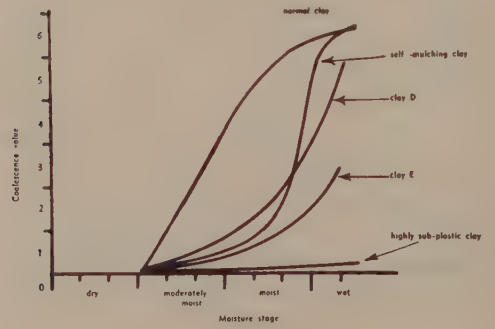

Figure 4.

Showing variations of plastic properties of different clay materials throughout the moisture range. "Normal clay" is the B horizon of Mundiwa loam (Smith, 1945), "self-mulching clay" is the A horizon of Yooroobla clay (Churchward and Flint, in press), and "highly sub-plastic clay" is the C horizon of Merungle loam (Taylor and Hooper, 1938).

Laboratory Correlations

The descriptive system has been developed without specific regard to the possibility of correlations with precise laboratory technique. And it is quite possible that any such techniques will need to develop an approach quite different from the expedients adopted in the field description method. Marshall and Quirk (1950) have studied the break-down of dry soil materials. They found that when dry soil was dropped

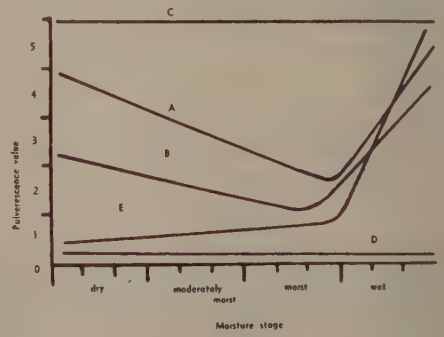

Figure 5.

Showing variations in the pulverescence value of different soil materials throughout the moisture range.

onto a hard surface, the product of the height of drop and the number of drops gave an index of the amount of breakdown. For example, 8 drops from a height of 60 cm. gave much the same result as 4 from 120 cm. Hence the breakdown of dry soil depends on the amount of work done on it, not on a certain yield point being exceeded. This conclusion does not, however, destroy the reality of the yield point in regard to the initial break of the piece before work is done on it.

The study of soil materials in the moist state will inevitably lead to their study as plastic substances, and for this the current elaboration of rheological techniques should offer a number of opportunities. The study of structure or fabric in soil materials by the physicist may well be based on a comparative study of physical properties before and after the fabric is destroyed, and the amount of work done in its destruction. The study of puddling in soils (Bodman & Rubin, 1949) may be a step in this direction.

Acknowledgment

The descriptive method presented here was developed over a period of about nine years, and many of the author's colleagues have materially contributed toward its present form. Among these the author is pleased to mention Dr. T. J. Marshall, Messrs. E. J. Johnston, R. Brewer, C. Hawkins, S. Flint and M. Churchward. The author is indebted to Dr. C. G. Stephens for reading the manuscript.

References

Anon (1948)—Report of the sub-committee on soil structure and soil consistence. National Soil Survey Committee Meeting at Guelph (Canada). Mimeo.

Bodman, G. B. and Rubin, J. (1949)—Soil puddling. *Soil Sci. Soc. Amer. Proc.* **13**: 27-36.

Butler, B. E., Baldwin, J. G., Penman, F. and Downes, R. G. (1942)—Soil survey of part of county Moira, Victoria. C.S.I.R. Bul. No. 152.

Churchward, H. M. and Flint, S. F. (in press)—Jernago extension of the Berriquin Irrigation District, N.S.W. C.S.I.R.O. Division of Soils and Land Use Series No. 17.

Hseung, Y., Marshall, C. E. and Krusekopf, H. N. (1949)—The origin of gumbotil. *Soil Sci. Soc. Amer. Proc.*, **14**: 311.

Hubble, G. D. (1948)—Soil survey notation. C.S.I.R.O. Division of Soils, Adelaide. Mimeo.

Johnston, E. J. (1953)—Pedology of the Deniboota irrigation district, N.S.W. C.S.I.R.O. Soil Pub. No. 1.

Marshall, T. J. and Quirk, J. P. (1950)—Stability of structural aggregates of dry soil. *Aust. Jour. Agric. Res.* **1**: 266-75.

Nikiforoff, C. C. (1941)—Morphological classification of soil structure. *Soil Sci.* **52**: 193.

Northcote, K. H., Russell, J. S. and Wells, C. B. (1954)—Soils and land use in the Barossa district, S.A., Zone I. C.S.I.R.O. Division of Soils, Soils and Land Use Series No. 13.

Russell, E. W. (1938)—Soil structure. Imp. Bur. Soil Sci. Tech. Com. 37.

Smith, R. (1945)—Soils of the Berriquin irrigation district, N.S.W. C.S.I.R. Bull. 189.

Smith, R. M. and Cernuda, C. F. (1952)—Some characteristics of the macrostructure of tropical soils in Puerto Rico. *Soil Sci.* **73**: (3), 183-92.

Templin, E. H., et. al. (1945)—Inspectors' committee on soil structure and soil consistence. *Soil Sci. Soc. Amer. Proc.* **10**: 479-81.

Taylor, J. K. and Hooper P. D. (1938)—Soil survey of the horticultural soils in the Murrumbidgee irrigation areas, N.S.W. C.S.I.R. Bull. No. 118.

U.S.D.A. (1951)—Soil survey manual. U.S. Dept. Agric. Handbook No. 18.

Yoder, R. E. (1937)—Significance of soil structure in relation to the tilth problem. *Soil Sci. Soc. Amer. Proc.* **2**: 21.

Zakharov, S. A. (1927)—Achievements of Russian science in the morphology of soils. Acad. Sci. U.S.S.R. (Leningrad) Russ. Ped. Invest. No. 2, 47.

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THE ECOLOGY OF THE MOSQUITO VECTORS OF MYXOMATOSIS (*CULEX ANNULIROSTRIS* SKUSE AND *ANOPHELES ANNULIPES* WALK.) IN THE EASTERN RIVERINA

By K. MYERS

Lake Urana, lying some 70 miles N.W. of Albury, N.S.W., in the Riverina plain, has been the site of field research on myxomatosis since 1951, when the disease first appeared there in epidemic form. Four outbreaks have now been witnessed at Urana, an epidemic having taken place every summer. The first two broke out violently in November, and died down just as suddenly in December. There was no epidemic at all in 1953, but another explosive outbreak occurred in February, 1954. In November of that same year, the disease again became active, lingering on until March, 1955.

Further south, in a little valley in the foothills close to Albury, the history of myxomatosis has followed an entirely different course. And it has been different again on the Murray River flats at Corowa, N.S.W., where epidemics have occurred in five successive summers.

The early vector work in the Riverina was mainly concerned with gross correlations between regional rainfall, mosquito activity and disease incidence. Although incriminating the principal vectors in the region, it provided little to explain the differences in disease history from season to season and habitat to habitat. Investigations of a more intensive kind were therefore initiated in 1953.

Three areas were chosen for this work —a section of the plains abutting Lake Urana; the foothill valley mentioned above; and about a square mile of river flats. The total surface water in each area was measured once every three weeks and sampled adequately, in a standard manner, for mosquito larvae and pupae. To facilitate the comparison of total production of mosquitoes under varying conditions, the water areas producing immature stages at different densities were converted into their equivalents producing larvae and pupae at the rate of 1 per square foot, this equivalent being termed the "Index of Production" (e.g., 1 square foot producing 2 immature stages would give an "index" area of 2 square feet).

At the same time, the activity of adult mosquitoes feeding on rabbits in their normal habitat was measured, using drop-traps replicated sufficiently for the purpose. Since mosquitoes harbour in warrens, sometimes feeding on rabbits while underground during the day, traps* were also devised to intercept possible vectors as they entered or left the burrows. Engorged insects were precipitin-tested for us by Mr. D. J. Lee of the School of Public Health and Tropical Medicine, Sydney. Figure 1, based on data collected over a 24-hour period (March 1, 1953) at Urana, demonstrates the type of information obtainable with this equipment.

Only two species of mosquitoes were resting in the warrens, *A. annulipes* Walk. and *Culex pipiens australicus* Dob. and Drummond. When both species

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*A detailed description of the drop-traps and burrow-entrance traps is being prepared for publication.

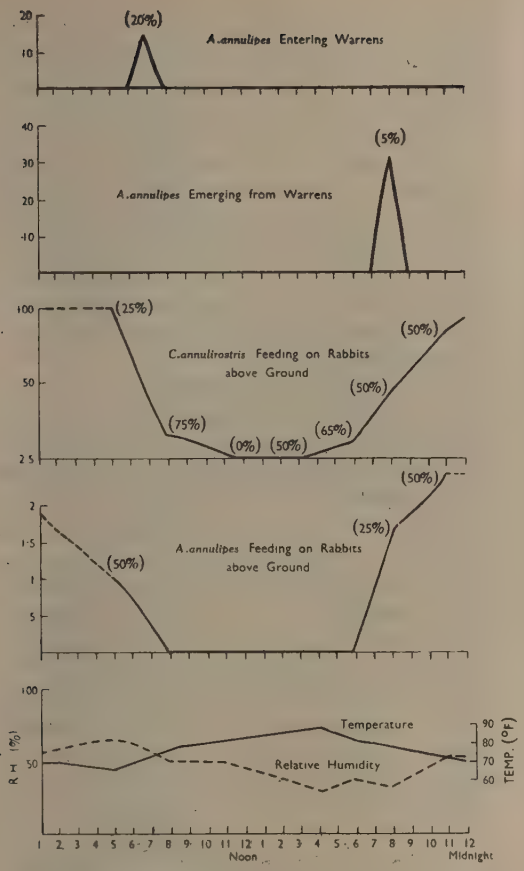


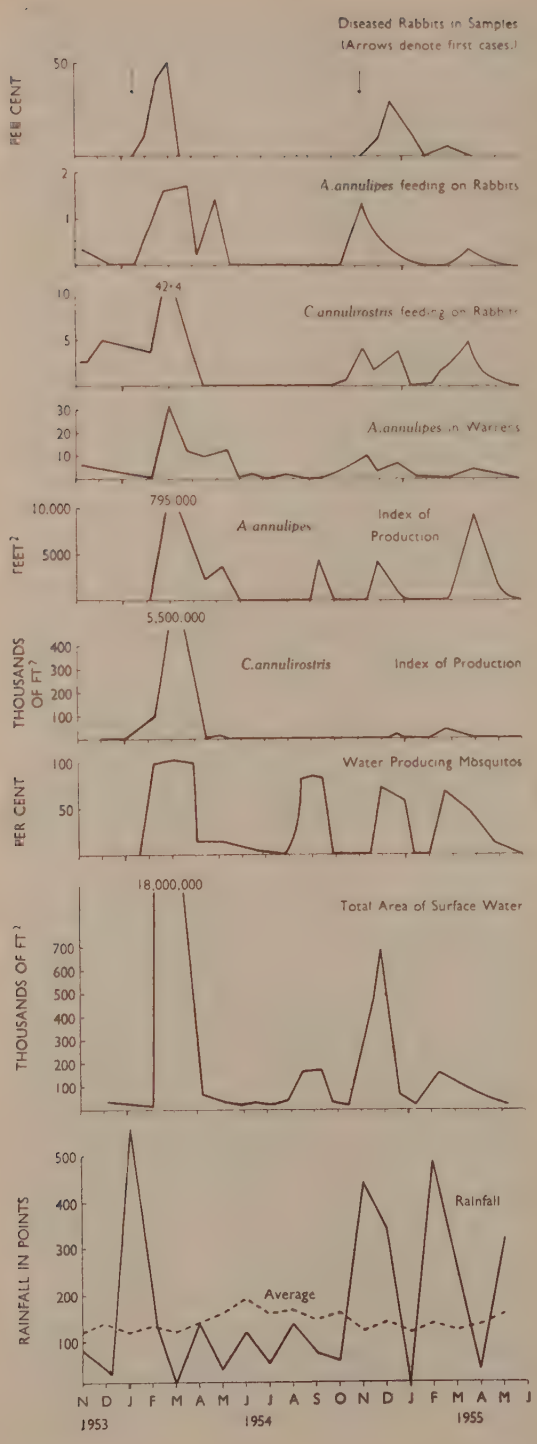
Figure 1.

Mosquito activity in warrens and on rabbit feeding grounds. Figures in brackets denote per cent. female mosquitoes caught engorged with rabbit blood.

emerged at dusk, 5 per cent. of the anopheline females were freshly engorged with rabbit blood, pointing to light feeding on rabbits below ground during the day. No blood-fed *Culex*, however, was present in the catches. Warrens, for this species, were merely resting places. Outside, at night, the rabbits were incessantly attacked by two species of mosquitoes, *A. annulipes* and *Culex annulirostris* Skuse. Here, also, *C. pipiens australicus* paid little attention to rabbits. After dawn, when the rabbits returned to their warrens, followed by *Anopheles* and *C. pipiens australicus*, 20 per cent. of the anopheline females were engorged, evidencing steady feeding on rabbits during the night. Even some *C. pipiens australicus* found rabbits to attack, since 0.5 per cent. of its females had also recently fed. Rabbits were thus under attack 24 hours a day by *A. annulipes*, and throughout the whole night, while they were above ground grazing, by *C. annulirostris*. At this time transmission of myxomatosis was occurring at a high rate and under similar circumstances (Myers, 1954; Myers, Marshall and Fenner, 1954) both species were shown to be carrying virus. *C. pipiens australicus*, although present in large numbers, and showing rabbit positives in precipitin tests, was evidently of little epidemiological importance.

Figure 2 shows how the results of our continuing study are shaping. The data graphed are limited to the two mosquito species now known to be the most important vectors of myxomatosis in the eastern Riverina. Only dusk catches over rabbit and warren emergence catches are used to indicate the changes in adult mosquito activity as they are related to the rabbit population. The data were obtained from the Urana area over the period November, 1953, to June of this year.

Neglecting the winter peak commencing in May, 1955, which occurred too late for any effects to be recorded, there were three large peaks in rainfall during this period. All of these peaks were immediately followed by increases in the area of surface water. In addition, a small increase occurred for a short time at the end of the winter (August/September, 1954), even though the winter rainfall had been well below normal. Insects took immediate advantage of these increases, and the actual percentage of water producing mosquitoes rose sharply in each case. There also occurred a small rise in production in the autumn of 1954, with no backing of rain and, in fact, a quickly decreasing surface water area. Thus there were actually five peaks in



mosquito production over the period studied.

C. annulirostris responded immediately to the three big peaks in rainfall—all falling in the warmer months of the year. *A. annulipes* on the other hand not only responded to the rainfall peaks, but also utilised the increase in surface water in early spring and suddenly took over the few waters remaining in the autumn of 1954. Thus, *A. annulipes* took some part in all five periods of mosquito production just mentioned.

Fluctuations in adult activity, as might be expected, are closely correlated with the five peaks in mosquito production, with one exception—an unexpected peak in adult activity in November, 1954. In the case of *C. annulirostris* there can be little doubt that this was due to a relatively large over-wintering adult population becoming active rather earlier than usual. The activity of *A. annulipes* can only be explained by assuming them to be over-wintering and winter and spring produced adults, suddenly becoming actively interested in rabbits or the shelter their burrows provided.

The data on disease activity at Urana during this period were collected by Mr. W. E. Poole, of this Section.* Following the heavy rains in February, 1954, at a time when myxomatosis was already being transmitted by a light population of *C. annulirostris*, there was an immediate outbreak with large numbers of *C. annulirostris* and *A. annulipes* attacking rabbits. The epidemic was over by early March, but continued on in the surrounding areas until well into the autumn, aided no doubt by the autumn wave of anophelines shown. In October, 1954, over-wintering adults of *C. annulirostris* first commenced feeding on rabbits; and by the beginning of November, odd sick rabbits were being sighted.

*C.S.I.R.O. Wildlife Survey Section.

Figure 2.

Rainfall and its effects on surface waters, mosquito production, adult feeding activity on rabbits and myxomatosis transmission.

Immediately following this, *A. annulipes* took to rabbit burrows, and the percentage of anopheline females emerging from burrows engorged with rabbit blood rose from 1 to 17. Above ground, both *A. annulipes* and *C. annulirostris* suddenly started feeding on rabbits, although not in large numbers, and active transmission occurred. This continued, reaching a peak after the early summer rains in December, and dying away, with *C. annulirostris* and *A. annulipes*, in January. With the second summer rains, and new mosquito production, more feeding on rabbits occurred and the last few susceptible rabbits in the population contracted the disease in March. Here, again, the epidemic continued on into the autumn in the region as a whole.

In 1951 and 1952, when both the epidemics were explosive November ones, the extremely wet winters preceding them placed the spring production of *A. annulipes* on a very high level, and ensured this species of a dominant place in the epidemics that followed. It is obvious, therefore, that when the winter rains fail at Urana, the annual epidemics depend upon peaks in summer rainfall, and take their timing from them.

The pictures emerging from the study areas on the river-flats and in the valley contrast strongly in details with that on the plains, but merely reinforce the conclusion that the variations in disease activity from place to place and year to year are reflections of the different ways in which the habitats and vectors respond to rain in season.

References.

Myers, K. (1954)—Studies in the epidemiology of infectious myxomatosis of rabbits. II. Field experiments, August-November, 1950, and the first epizootic of Myxomatosis in the Riverina Plain of south-eastern Australia. *J. Hyg., Camb.* 52: 47-59.

Myers, K., Marshall, I. D., and Fenner, Frank (1954)—Studies in the epidemiology of infectious myxomatosis of rabbits. III. Observations on two succeeding epizootics in Australian wild rabbits on the Riverina plain of south-eastern Australia, 1951-1953. *J. Hyg., Camb.* 52: 338-360.

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BOOK REVIEWS

BETTER FARMING DIGEST

(*Vol.* 1, *No.* 1, *June*, 1955. *Edited by W. F. Ritchie, B.Agr.Sc. Published monthly by the Sydney and Melbourne Publishing Co. Pty. Ltd.*, 27-29 *Alberta Street, Sydney, N.S.W. Melbourne office: Newspaper House*, 247 *Collins Street, Melbourne. Price, A* 24/- *per annum.*)

This new journal of typical "digest" size aims to summarise the achievements of farmers and the results of research being conducted in Australia and overseas. Articles have been condensed from such sources as the journals of the various State Departments of Agriculture, C.S.I.R.O. publications, A.B.C. broadcasts, the U.S. Information Service and Australian and overseas journals.

The material is summarised well and is presented in a pleasant style so that the net result is a journal which can be widely read and appreciated by farmers and also by those interested in agriculture generally.

Provided the present high standard of publication is maintained there is little doubt that this "Digest" will develop into one of the most worthwhile written extension media in Australia.

THE DETERMINANTS OF AGRICULTURAL EFFICIENCY

By KEITH O. CAMPBELL

Once it was generally accepted that the way to ensure a country's prosperity was to turn out goods of superior quality more cheaply than other countries: that if you could make a better mouse trap, the world would beat a path to your door. However, in the period since 1939 this emphasis on efficiency has been largely eclipsed so far as Australian agriculture has been concerned. Instead of going all out for greater efficiency, we have preferred the easier life made possible by negotiated sales. As the *Economist* recently put it, we have preferred to participate in a gentleman's agreement, whereby other people undertake to buy our second-class mouse traps if we undertake to buy their second-class cheese. But all this is rapidly changing. A revival of the former interest in production efficiency became manifest when the British Government, late in 1953, decided to have done with state trading. The Australian Agricultural Council at its meeting in July, 1955, made it very plain that efficiency objectives once again had a very high priority in agricultural policy.

The Meaning of Efficiency

"Efficiency" is one of those words which have different meanings for different people. In physical terms, it is essentially a ratio of the rate of (useful) output to the rate of input of a particular resource. There is obviously scope for a host of different measures of what is generally known as technical efficiency, depending on what is included in the categories output and input. Agronomists and animal husbandrymen, as well as engineers and others concerned with production problems, are accustomed to use such measures with respect to a wide range of input-output relationships. Measures of this kind are used, for example, to assess the efficiency of dairy cows in turning feed into milk, or the relative efficiency of different wheat varieties in turning solar energy into grain. Such measures of technical efficiency are useful for many purposes, but they have limited value in an organisational or policy context. They can, in fact, be positively misleading, particularly if maximisation of the physical output in relation to one particular resource becomes an objective of action. For instance, the achievement of extraordinarily high yields of hybrid maize on the demonstration plots of commercial distributors through the application of virtually unlimited quantities of fertilisers and cultural care, represents, in many cases, wasteful rather than efficient use of resources.

It is clear then that some other standard is needed to evaluate the efficiency of a production process. We must have some regard to the relative preferences which the community has for particular commodities and also to the relative scarcity of different resources. In short, we must evaluate efficiency in terms of the value of the commodity produced and the costs of the various resources employed in its production. Judging the efficiency of production processes from the standpoint of this broader concept is an essential aspect of the science of economics. A necessary condition of maximum economic efficiency is that, with given resources, technology and consumer preferences, these resources

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cannot be reallocated in such a manner as to increase the total output of commodities obtained. In practice, such a neat balance in the use of resources is rarely achieved, basically because production decisions have to be made on imperfect knowledge of future yields and prices.

The Measurement of Economic Efficiency

The measurement of efficiency in the aggregative sense raises all sorts of statistical problems, which cannot be explored in this paper. The traditional practice is to use money returns as an index of efficiency on the individual farm; that farm which gives a higher return per unit of resource being classed as more efficient than one with a lower return. Similarly at an industry or a national level it is usual to employ the value of production per unit of resource as an efficiency indicator. Since the object of economic activity is to satisfy human wants with the least expenditure of effort, the value of production or aggregate output is frequently related to the labour input. Thus it is usually accepted that an increase in output per man, or more precisely per man hour, indicates an improvement in economic efficiency.

Aspects of Agricultural Efficiency

The achievement of a high level of productivity in the agricultural industry is dependent upon the manner in which resources are allocated at various points within the industry, namely: (1) within the individual farm, (2) between farms in the same region and (3) between differing farming regions. The efficiency of any industry may further be affected by conditions arising from the allocation of resources between that industry and other sectors of the national economy. For instance, the level of agricultural efficiency achieved may be affected by the existence of a shortage or surfeit of labour in agriculture relative to secondary industry. In addition to these more or less controllable elements, there are in the Australian scene two largely uncontrollable factors which vitally affect the productivity of our agricultural industries. One is the nature of the seasons and the second is the prices obtained for our rural exports.

The many aspects of efficiency which arise in each of the situations listed cannot be considered within the confines of this paper. I shall restrict my comments to two of them: (1) the organisation and management of the individual farm, and (2) resource allocation between industries.

The Improvement of Efficiency on the Individual Farm

Clearly the skill with which resources are allocated on individual farms will have an important bearing on the aggregate efficiency of agriculture. The aim of the science of farm management is to provide guides for the farmer in maximising his profits. This country has lagged behind other advanced countries in the emphasis it has placed on work of this nature, though there are now some signs of increasing interest. Four possible reasons might be advanced to explain why farm management has not received greater attention in this country.

(1) By training, our agriculturalists have been conditioned to look at the farm business in terms of what Forster (1953, p.129) has called "morselisation"—the splintering of farm activities into distinct parts—rather than as an integrated entity functioning within defined resource limitations. Sir James Scott Watson (1954) recently has drawn attention to similar shortcomings among farm advisers in the United Kingdom.

(2) The existence of a very high degree of production uncertainty in Australia limits the usefulness of the farm management approach, which, until very recently, has been developed in an essentially static frame of reference.

(3) Under conditions of extensive agriculture based on pastures, and where enterprises, though diversified, are not highly integrated, detailed problems of management are not so pressing as under more intensive systems of agriculture.

(4) It may be, as Bradford and Johnson (1953, p.17) suggest, that where technological advances are forthcoming at a high rate, questions of technical method tend to overshadow questions of more efficient use of existing technology.

Whatever the limitations of the discipline of farm management, and whatever the reasons for its comparative neglect in this country hitherto, there can be no doubt that it has important contributions to make if we are interested in raising the standard of efficiency on farms. I turn now to consider some specific factors affecting the productivity of the individual farm.

(1) *The Selection and Combination of Enterprises*

One should not accept arguments for diversification that are based solely on technical grounds. Where, however, either the so-called supplementary or complementary relationship exists between different enterprises the combining of such enterprises may be highly advantageous. But even when these relationships are known to be operating, the ultimate choice of, say, one particular rotation out of a series of possible alternative rotations should be made by reference to costs and prices. A critical point in enterprise selection for maximum efficiency is to try to ensure that the permanent labour force is fully employed when peak labour demands occur, and further, to ensure that such labour is utilised as fully as possible in other seasons. The farm operator has quite a deal of flexibility in the ordering of farm tasks to this end.

(2) *Management of Labour*

Four major factors determine the output of the farm work force: (1) its basic skills, (2) the actual effort expended, (3) the way it is organised and (4) the equipment with which it has to work. Skill is an attribute which is given in the short run but which can be improved in the long run through the normal educational system and the extension services.

How hard a particular farmer works is essentially an expression of his relative preference as between income and leisure. No one denies the farmer's right to make a personal choice as to the amount of leisure he wants. There is, moreover, every reason to believe that the length of his working week will decrease over time. What is important is the degree to which the work effort is affected by institutional arrangements external to the farm. It might be said that the "darg" (a trade union limitation on the daily output of a worker) is part of the Australian way of life. In farming, part of the disincentive to effort comes from the progressive income tax, and there is no doubt that this has a vital influence on the self-employed farmer. I sometimes wonder whether at the present stage of economic development, some reduction in the rate of progression of the tax structure might not have quite a marked favourable effect on the Australian balance of payments. The present special tax allowances to primary producers provide incentive to develop a property rather than to use existing resources to capacity.

Most farms offer considerable scope for improved organisation of the work force. Farm work simplification has made rapid advances in the past decade. Some phenomenal reductions in labour demands have been achieved as a result of studies in this field. Work simplification finds its greatest application in routine operations such as feeding livestock, milking cows and harvesting horticultural crops. The reduction in labour requirements is achieved both by improved work routines and through the provision and placement of suitable equipment.

(3) *Size of Farm*

Farm size is a matter which in some aspects transcends the level of the individual farm. But it is obvious that, for maximum efficiency, the farm must be large enough to provide full employment for the operator throughout the year. This is in some ways a counsel of perfection. Different farmers have differing managerial capacities. Their labour capacity varies throughout their working life. Furthermore, the optimum size of farm may change over time as a result of technological advance. Still the fact remains that bringing the labour force reasonably into line with other fixed factors of production is a prerequisite of efficient operation.

As yet we have practically no precise data relative to the economies of scale in Australian farming. Parish and Dillon (1955) have recently obtained some results from farms on the South-Western Slope of New South Wales which strongly suggest increasing returns to scale. We need more evidence on this point and when we get it we should take heed of it in formulating government policy if we are determined to give efficiency high priority as a national objective.

(4) *Availability of Capital*

The productivity of the farm labour force will obviously be a function of the capital equipment with which it has to work. Substitution of capital for labour is one manifestation of technological progress. The optimum amount of machinery for the individual farm will be determined by the relative costs of labour and machinery, the amount of capital available and the size and efficiency of the family labour force. In many cases, it is useful to plan operations in terms of a composite labour and machinery unit, e.g., one man plus a tractor plus associated equipment (ploughs, drills and harvesters) of suitable capacity. To secure necessary equipment, the farmer has to resort to external sources, and any imperfections in the functioning of the relevant markets (both in respect of credit and goods) may have repercussions on the level of efficiency he can attain.

(5) *Economic Use of Factors of Production*

For maximum efficiency, a particular factor of production should be employed up to the point where the cost of using an extra unit of the factor will be just equal to the value of the extra production obtained. Though the determination of the optimum rate at which to employ individual factors is perhaps the simplest problem in farm management, in practice there is vast scope for improvement. Fertiliser recommendations, for instance, often understate the economic rate of application. In part the trouble lies in the design of experiments, in part it arises from a failure to weigh costs and returns. Similarly, on the labour side, the unpublished data of Parish and Dillon suggest that farmers on the South-Western Slope of New South Wales could profitably employ more labour and pay it better.

Allocation of Resources between Agriculture and the Rest of the Economy

In the process of the economic development of a country, the natural tendency is for the rural labour force to decline in relative importance, while agriculture's external capital needs tend to increase. If for any reason, the outflow or inflow of a resource does not proceed at a sufficiently rapid rate, agricultural efficiency may drop substantially below what is otherwise possible. The aggregate efficiency of American agriculture is relatively low, because of the excessively large labour force in some sections of that country. Consequently American economists and legislators are apt to make a great deal of this aspect of efficiency (Schultz, 1947).

Fortunately for us in Australia, the rural exodus or "drift to the city" has proceeded without much friction. Indeed, there are signs at times that it has proceeded too far. Even so, rural and

urban wages appear to be far from equal (Campbell, 1955, p.9). On the capital side, Australian agriculture, which is heavily dependent on the banking system to channel external capital into the industry, suffers from most of the imperfections that are usually found in rural credit arrangements.

Governments can, by legislative action, affect the balance between agriculture and industry. For instance, they may impose tariffs, or they may adopt agricultural pricing schemes which have the effect of making the terms of trade less favourable to agriculture. Both these techniques have been employed in this country. On the positive side, government may offer special credit facilities to agriculture, or grant it favourable tax treatment.

Subventions for Agricultural Research and Extension

A society, in addition to its endeavours to achieve maximum efficiency from the resources and technology available to it at a given point of time, also has an interest in seeing that efficiency is rising in a secular sense. To this end it is usual, at least in advanced countries, to divert a portion of the resources available to a search for new and better techniques and to the dissemination of knowledge of these techniques as they become available. By the same token efficiency can always be increased at a given point of time, through extension work aimed at putting the more efficient techniques already known into more general practice.

The size and distribution of government subventions for rural research and extension obviously have an important bearing on the probable rate of increase of productivity. There is much to be said for endeavouring to make research allocations in as rational and efficient a manner as possible. Attempts such as that of Schultz (1953) to assess costs and benefits from research expenditure in the aggregate, have indicated that far too little is being spent, judged in terms of ordinary economic criteria. When it comes to the allocation of research funds within agriculture, the guide lines are less clear. Most technological advances are resource-saving in nature, but this aspect needs to be emphasised in research policy when supplies of a particular resource are limited or likely to become so. It has also been suggested that it is wise to concentrate research upon those products which have higher price and income elasticities (that is, those products of which consumers buy relatively more as prices or incomes rise). It would also be appropriate to focus research on those products whose relative prices are rising and especially on those production factors the costs of which are increasing (Fisher, 1953).

In this country there is an increasing tendency to allocate public research funds to individual industries according to their own capacity to support research activities. It is true that part of the Government's subvention for research has no strings attached. But the practice of using funds from specific marketing boards, supplemented by matching Treasury grants, is increasing. This criterion for allocating research funds is surely open to question. There is, first, the more general question as to whether it is equitable to place a direct levy on a primary industry in order to finance a research programme, if as is quite possible, it gains little direct benefit in the long run from any resultant increase in productivity. But quite apart from this, the mere fact that woolgrowers, for instance, secured "windfall" profits in certain years, is clearly not in itself a justification for the disproportionate amount of research resources which are being narrowly devoted to wool research today. After all, graziers in the wheat belt, whose incomes were swelled as a result of wool prices received in recent years, did not use their profits solely for investment in the wool enterprise but diverted a portion of them to the purchase of wheat machinery.

Efficiency as an Objective of Policy

Because increasing efficiency brings in its train so many social and economic benefits to the individual and the nation, it has been given rather high priority as an end in most Western societies. However there are other ends of policy, and these often conflict with the efficiency objective. To illustrate—the individual farmer who goes in for diversification may be doing so to ensure a more certain income. But having "more than one string to your bow" almost inevitably means a reduction in production efficiency, and probably lower money returns. Likewise, at the industry level, the people, through their elected representatives, may decide to introduce some form of price stabilisation instead of leaving prices to find their own level. This, again, frequently involves a sacrifice of efficiency in the industry concerned (Campbell, 1950). Again there are groups in the community which urge the establishment of subsistence farms on a considerable scale, for reasons which are generally described as "non-material." When broad social issues of this kind are at stake, the economist, in his professional role, can merely underline the loss of economic welfare that the pursuit of such non-economic objectives entails.

References

Bradford, L. A. and Johnson, G. L. (1953)—"Farm management analysis," John Wiley and Sons, New York.

Campbell, K. O. (1950)—*J. Aust. Inst. Agric. Sci.*, **16**: (4), 150-153.

Campbell, K. O. (1955)—Current agricultural development and its implications as regards the utilisation of resources, Paper read to Section G, A.N.Z.A.A.S., Mimeo.

Fisher, J. L. (1953)—*Land Econ.*, 29: (1), 63-64.

Forster, G. W. (1953)—"Farm organisation and management," Prentice-Hall, New York.

Parish, R. M. and Dillon L. (1955)—Personal communication.

Schultz, T. W. (1947)—*J. Farm. Econ.*, **29**: (3), 644-658.

Schultz, T. W. (1953)—"The economic organisation of agriculture," McGraw-Hill Book Co., New York, 99-124.

Scott Watson, J. (1954)—*N.A.A.S. Quart. Rev.*, 26: 47-49.

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APHANOMYCES ROOT ROT OF PEAS—THE EFFECT OF A POTASSIUM FERTILIZER ON THE SEVERITY OF THE DISEASE IN A POTASSIUM DEFICIENT SOIL

By G. C. WADE

Summary

Analyses of pea plants affected with Aphanomyces root rot showed that they had a lower potassium content than healthy plants. In a greenhouse experiment the application of potassium chloride at the rate of 4 cwt. per acre, reduced the severity of Aphanomyces root rot. In canisters subjected to saturation for one week, potassium chloride reduced the number of plants killed and, in canisters held at normal moisture content throughout, it reduced the number of plants which became infected. Potassium chloride resulted in an improvement in growth in both soil saturated for one week, and soil held at normal moisture content.

Introduction

Aphanomyces root rot of peas has been recorded in Tasmania for many years, McLennan (1926) and Geach (1936) and it was responsible for heavy losses at the time of those workers' investigations. Later, the disease declined in importance and, for a number of years prior to 1953, it did not cause economic loss. But in December, 1953, widespread damage to grey pea crops occurred in the Longford-Cressy district, and over 1,000 acres of peas failed to produce a satisfactory crop as a result. Some damage to blue peas due to the same cause occurred in the Westbury district.

The disease followed a period of heavy rain during the period from November 2 to 6, when 160 points were recorded at Cressy. It was noticeably more severe in flat, low lying situations with badly drained soils with poor texture. The plants in large areas in such situations became chlorotic and stunted, and the roots were decayed. Numerous oospores of Aphanomyces were found consistently in the roots of such plants. However, even in badly affected paddocks, some plants made normal growth and it appeared that some nutritional factor may have modified the severity of the disease. Therefore, samples of peas and soil from good and bad areas were taken and analysed, with the results shown in Table I. All samples, except Winkleigh (healthy), were taken from crops in the affected area. Analyses are on an oven dry basis.

The most striking result of these analyses was the considerably lower potassium content of all the unhealthy plants, as compared with healthy plants. This applied even in the case of Cressy A, when the healthy and unhealthy samples were taken from the same crop. The soil pH was satisfactory for peas in all cases, and the soluble salt contents of all the soils were well below toxic levels. To determine whether added potassium would reduce the severity of the disease the following experiment was performed.

Experimental Method

Soil from a heavily infected area in the Cressy District was obtained, and the moisture holding capacity determined according to the method described by Riker and Riker (1936). Nine pounds of air dry soil was placed in each of thirty 8 in. diameter tin canisters, which had been painted with a bituminous paint to prevent rusting. The soil was then brought to 50% of the Moisture Holding Capacity

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TABLE I.

Analysis of plant and soil samples from healthy and unhealthy plants.

Sample	Plants			Soil				
	Potassium Total K_2O %	Calcium Total CuO %	Phosphorus p.p.m. P (Morgan extract)	pH	Total soluble salts	Potassium (Morgan extract) p.p.m. K	Calcium (Morgan extract) p.p.m. Ca	Texture
Cressy A (unhealthy)	0.5	1.4	15	5.7	0.035	5	Low	Clay loam
Cressy B (unhealthy)	0.3	0.6	8	5.7	0.024	10	Low	Clay loam
Westbury (unhealthy)	0.2	3.0	10	5.7	0.040	5	High	Clay loam
Westn. Junc. (unhealthy)	0.4	0.9	3	5.9	0.033	14	Medium	Clay
Cressy A (healthy)	1.0	1.7	16	6.1	0.017	6	Low	Clay loam
Cressy C (healthy)	1.5	1.1	39	5.5	0.039	40	Low	Clay loam
Winkleigh (healthy)	3.4	2.2	23	5.5	0.019	60	Medium	Clay loam

and thoroughly mixed. Six of the canisters were autoclaved, and potassium chloride at the rate of 4 cwt. per acre worked into the surface of 12 of the remainder. Twenty-four grey pea seeds were then sown in each canister, the number being reduced to 16 after germination. The canisters were weighed approximately every second day throughout the experiment and water added to bring the weight to that of canister plus soil at 50% of the M.H.C. When the plants were approximately 4 in. high six of the canisters with and six without added potassium chloride and the autoclaved canisters were brought to the full M.H.C. and maintained in that condition for one week, when the soil was allowed to dry out to 50% M.H.C. Thereafter the moisture supply was regulated as previously described. As pointed out by Hendrickson and Veihmeyer (1941) added water does not become distributed evenly so that the two moisture levels should be referred to as "normal" and "saturated".

The experiment was continued for 9 weeks, when the plants were removed complete with the root systems, which were separated from the soil by washing and sieving. The length of all plants was measured, and the severity of Aphanomyces infection rated according to the following scale:—0 = healthy; 1 = slight collar and tap root lesions; 2 = moderate collar and tap root lesions; 3 = severe collar and tap root lesions but fibrous roots fair; 4 = collar, tap and fibrous roots almost entirely destroyed. An infection rating for each pot was then calculated. Tops and roots were then allowed to become air dry and the bulked sample from each canister was weighed.

Results

Initial germination and growth was satisfactory in all canisters. After waterlogging, all plants in the waterlogged canisters, including those in sterilized soil, developed a greyish colouration and downward rolling of the leaflets. After this stage marked differences began to develop between treatments. The sterilized, waterlogged plants rapidly recovered and resumed normal growth. On the other hand the plants in the waterlogged, unsterilized canisters without added potassium became chlorotic, and growth was severely reduced. Symptoms of Aphanomyces soon became apparent on the collar region of the plants, and 19 plants out of 96 died before the conclusion of the experiment. Growth in the corresponding series to which potassium chloride had

been added was very much better, chlorosis was not marked, and only one plant died during the experiment. A very striking difference between the growth of unwaterlogged canisters with and without potassium chloride soon became evident, and Aphanomyces attack was much more obvious on plants without potassium than on those with added potassium.

The results at the conclusion of the experiment are shown in Table II.

The results show clearly the marked influence of high moisture content on the development of the disease. On the basis of disease rating, and on the plant growth criteria, the plants which had been held at high moisture content for a week suffered more severely from Aphanomyces attack than the equivalent series which had been held at 50% M.H.C. throughout. The effect of high moisture on the disease has been established in previous investigations, e.g., Geach (1936) and Smith and Walker (1941). However, saturating autoclaved soil for one week did not have a serious effect on plant growth, so that waterlogging in itself was not responsible for the growth reduction.

In the series which were not saturated for one week potassium dressings very greatly reduced the severity of lesions, and the growth was significantly superior according to all the criteria measured. In soil which was saturated for one week the application of potassium chloride almost eliminated plant deaths, and although the majority of plants became infected the symptoms were less severe, and the growth of both tops and roots was much better than in the saturated series without added potassium.

Discussion

The results presented here show that under glasshouse conditions the addition of a potassium fertilizer to a soil of low potassium status reduces the severity of Aphanomyces lesions, reduces the number of plants killed by the disease in soil subjected to a period of water saturation,

TABLE II.

Effect of waterlogging and KCl on severity on Aphanomyces.

Treatment	Aphanomyces rating	Length in cms.	Weight of tops in grms.	Weight of roots in grms.	% plants free of symptoms	% plants dead
Held at 50% M.H.C.	1.95	27.4	5.1	2.0	2	0
KCl added, held at 50% M.H.C.	1.18	37.3	6.5	2.9	14	0
Held at M.H.C. 1 week then at 50% M.H.C.	2.90	22.2	3.2	0.6	0	19
KCl added, then at M.H.C. 1 week, then at 50% M.H.C.	2.03	32.7	4.8	1.3	2	1
Autoclaved, held at M.H.C. 1 week, then at 50% M.H.C.	0.01*	40.1	5.7	2.2	89*	0
Least difference for significance @ 5% level	0.43	1.6	1.1	0.6		
Least difference for significance @ 1% level	0.59	2.2	1.5	0.8		

*Slight discolouration was present on collar region of some plants and was scored as rating 1, as it was impracticable to check for presence of Aphanomyces in all plants.

and reduces the number which become infected when the soil is maintained throughout at a normal moisture content. Potassium applications also increased the growth of plants grown in unsterilized naturally infected soil, but the experiments do not provide evidence of how much of the improvement is a simple potassium response and how much is due to the reduction in severity of Aphanomyces. The disease did not occur in the field in the subsequent season, and there has been no opportunity to determine whether the results apply under field conditions.

It has been mentioned by a number of workers that an improvement in the nutrition of the plants reduces the severity of the disease. Haenseler (1931) found that nitrate of soda, sulphate of ammonia and potassium chloride reduced the development of the disease in greenhouse tests, being more effective than superphosphate. Heavy applications of complete fertilizers in the field reduced the severity of root rot and greatly increased yield. Similarly Walker (1933) found that a 500 lb. per acre application of 4.16.4 fertilizer caused a marked reduction in the severity of the disease. In experiments in sand culture Smith and Walker (1941) found that the disease was reduced by an increase in nutrient concentration, but did not find a relation between it and concentration of individual elements. They suggested the osmotic effect of high concentrations of soluble salts may be more important than the nutrient effect. However, they did not obtain control by application of 2.12.6 fertilizer to the soil at a lower dosage rate than 760 lb. per acre. As 4 cwt. per acre of potassium chloride was effective in the experiments described here it would appear that the nutrient effect is a more probable explanation of the response than osmotic effect, particularly as the soil studied had a low soluble salt content.

Acknowledgment

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References.

Geach, W. L. (1936).—Root rot of grey peas in Tasmania. *J. C. S. I. R.* (Aust.) **9**: 77-87.

Haenseler, C. M. (1931)—The use of fertilizers in reducing losses from pea root rot caused by *A. euteiches*. Abst. in *Phytopath* **21**: 116-117.

Hendrickson, A. H. and Veihmeyer, F. J. (1941)—Moisture distribution in soil in containers. *Plant Physiol.* **16**: 821-6.

McLennan, E. (1926)—Unpublished report quoted by Geach.

Riker, A. J. and Riker, R. S. (1936)—Introduction to research on plant diseases. (John S. Swift & Co., St. Louis).

Smith, P. G. and Walker, J. C. (1941)—Certain environal and nutritional factors affecting Aphanomyces root rot of garden pea. *J. Agr. Res.* **63**: 1-20.

Walker, J. C. (1933)—The relation of soil fertility to incidence of Aphanomyces root rot of peas. Abst. in *Phytopath.* 23:36.

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ERRATUM

The following correction is made to the "Technical Note" on "Deep placement of rhizobial cultures as an aid to legume inoculation", by Dr. A. J. Millington, which was published in the June, 1955, *issue, Vol.* 21, *No.* 2, *page* 102.

The first five lines of the second last paragraph on this page should read:—

"All the plots were sampled at the end of September to a depth of 5 inches but there was practically no root development beyond 3-4 inches. The plants from 'deep placement' plots could be . . . ."

TECHNICAL NOTES

LIME PELLETED CLOVER SEEDS FOR NODULATION ON ACID SOILS

Nodulation of subterranean clover sown on new land is defective in many areas of the Southern Tablelands of New South Wales where the soil is more acid than pH 5.5. Field experiments have been conducted in such an area at Rye Park, N.S.W. Attempts to establish a subterranean clover pasture (var. Mount Barker) some years ago on a property at Rye Park failed: no clover plants can now be found in that pasture except on isolated ash patches. The pH of the soil is about 5.2 in the experimental area.

The purpose of this note is to record the very marked benefit that has been obtained from a small amount of lime pelleted on the seed, in overcoming the harmful effects of soil acidity on nodulation.

Seed was pelleted with finely ground calcium carbonate (5 lb. of lime to 10 lb. of seed) after inoculation with *Rhizobium*. This treatment was compared with inoculated seed sown without lime, and also with inoculated seed drilled with 224 lb. of calcium carbonate per acre.

The seed used was subterranean clover var. Bacchus Marsh, and the inoculum was a commercial peat culture. The seed was inoculated by the wet method using a sugar solution, and no other special materials were added for sticking the lime to the seed. As a consequence the pellets were probably too soft for commercial use, but were sufficiently stable for sowing by hand in the experiments.

The seed was sown the day after inoculation and pelleting, on June 15, 1955, at 10 lb. per acre, in drill rows on plots seven links square. There were eight drill rows in each plot. In all the plots 2 cwt. of superphosphate per acre was applied in a band below the seed and not in contact with it. A basal dressing of 2 oz. of molybdenum trioxide per acre and $3\frac{1}{2}$ lb. of borax per acre was also applied. There were eight replications of each treatment, randomised throughout the experiment.

On October 13, the centre 5 links of the six centre rows of each plot were harvested. The green and yellow plants were sorted and the oven dry weights determined. Examination of the roots of sample plants showed that the former were nodulated and the latter not.

Table I shows that where seed was sown without lime only 31 per cent. of the plants were nodulated. This value actually includes the data from one plot which was obviously influenced by a small patch of ash, and which had 93 per cent. of nodulated plants. On the other seven plots only 22 per cent. of the plants were nodulated. Experience has shown that with such poor nodulation it may take two or more years before a satisfactory pasture is developed.

It is known that 2 cwt. of lime per acre is effective in inducing nodulation even on the most acid soils encountered on the Southern Tablelands. The present results show that lime pelleted seeds may be almost as effective as 2 cwt. of lime per acre under some conditions and in practice may be quite as effective over a large area.

A particular advantage of the pelleted seed would appear to be on the soils where nodulation is not fully satisfactory, but where the additional expense of sowing the seed with 2 cwt. of lime per acre or with a lime-superphosphate mixture is not warranted. At the rate of seeding normally used (3 lb. of seed per acre) to

TABLE I.

Effect of lime pelleted on the inoculated seed, on the establishment, nodulation and yield of subterranean clover.

Treatment Number	Lime ($CaCO_3$) lb. per acre		Number of plants per acre	Percentage of plants nodulated	Dry matter
	Drilled with seed	On pelleted seed			
	lb.	lb.	(thousands)	(%)	(cwt. per acre)
1	0	0	328	31	0.65
2	0	5	419	91	3.00
3	224	0	411	99	3.60
4	224	5	441	100	3.43
Differences significant at P = 0.05 at least			1<2,3,4	1<2<3,4	1<2,3,4

develop pasture, the amount of lime on the pelleted seed would add even less than 5 lb. per acre. Furthermore, the use of lime pelleted seed could eliminate the need for mixing the superphosphate and lime, or the need for applying lime in a separate operation. Pelleted seed might well also have a further application where seed is mixed with superphosphate and broadcast, and in the seeding of pasture by aeroplane.

We think that it should be possible to develop methods of pelleting seeds with lime that would benefit many areas. It is hoped that this note will stimulate interest in the development of lime pelleted seed for pasture establishment.

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THE EFFECT OF AMMONIA INCORPORATED IN SUPERPHOSPHATE ON THE NODULATION OF CLOVER ON ACID SOILS

Present methods of establishing clover pastures on the more acid soils rely on drilling seed with lime or with lime-superphosphate mixtures. Neither of these methods is entirely satisfactory with the machinery available. Drilling seed with lime doubles the operations as there is only one fertiliser box. Mixing lime with superphosphate reduces the amount of phosphate which can be drilled. These are often handicaps where it is desired to bring an area into high production quickly. It seemed to us that ammoniated superphosphate might be an excellent fertiliser for such areas, besides being of benefit where there is no serious problem of nodulation. To be effective, ammonia treatment of superphosphate would need not only to neutralise superphosphate but also to counteract soil acidity for a sufficient time to permit nodulation.

A pot experiment was designed to test the effectiveness of ammoniated superphosphate on the nodulation of subterranean clover. Soil of pH5.2 from Black Mountain, Canberra, was used. Treatments were tested on this soil, on the same soil which had been mixed thoroughly with 5 cwt. of calcium carbonate per acre (pH 5.2) and again where it had been mixed with 20 cwt. of calcium carbonate per acre (pH 5.9). For all treatments the clover seed (*Trifolium subterraneum* L. var. Bacchus Marsh) was inoculated at field level with an effective strain of *Rhizobium* grown on yeast-water agar. Ammoniated superphosphate was not available commercially and was prepared in this laboratory. The superphosphate absorbed 5.7 lb. of ammonia per cwt. (equivalent to 22.5 lb. of ammonium sulphate) and the product gave a pH of 7.5 in aqueous suspension.

The treatments used and the results obtained are indicated in Table I. For the first treatment given in Table I (super 224 below seed), superphosphate was placed in a band at 1 inch depth, the band was covered with soil, and the seed was sown directly above the superphosphate at a depth of half an inch. In all the other treatments the seed and fertilisers were mixed and applied together in a single row at a depth of half an inch. The lime-superphosphate mixture had stood for six months before use. After germination the plants were thinned to 10 per pot. There were 4 pots per treatment. Five weeks after sowing, by which time marked treatment differences were apparent, the plant roots were washed out of the soil and the nodules counted.

Table I shows that ammoniated superphosphate greatly enhances the nodulation of subterranean clover plants even on quite acid soils. That this is not due to the presence of nitrogen alone is quite clear from the behaviour of seeds sown with superphosphate and ammonium sulphate. Other pot experiments at present in progress on this and another soil (pH 5.1) indicate similar findings.

The lime-superphosphate delayed germination so that at harvest some plants of this treatment had not developed unifoliate leaves. These newly germinated plants without unifoliate leaves were not included in the harvest. Table I shows that the lime-superphosphate treatment markedly improved the nodulation of the plants in the acid soil. It had little effect on the yield in comparison with superphosphate only but the plants were distinctly darker green, and experience has shown that the yield of these darker green nodulated plants would soon be much greater than the yield of the unnodulated plants sown without lime.

The higher yield and the greater number of nodules for the ammoniated superphosphate treatment than for the lime-superphosphate treatment (Table I) is due in part to the effect of the latter in delaying germination. This higher yield is probably due also in part to the nitrogen supplied in the ammoniated superphosphate as indicated by the increase in yield obtained by the addition of ammonium sulphate to the superphosphate.

Provided that ammoniated superphosphate proves to be as effective in the field as in pots, these results indicate that ammoniated superphosphate may have an important place in the establishment of pasture on acid soils. It has advantages over lime-superphosphate mixtures in simplicity of preparation and in the much higher content of phosphate per unit weight. As acid soils on which nodulation is defective are normally extremely low in nitrogen, the nitrogen supplied in ammoniated superphosphate should give a valuable increase in pasture production in the first year of establishment. Ammoniated superphosphate appears to have a particular application where seed and fertiliser are drilled on a prepared seed bed when it is desired to bring an acid soil into high production quickly.

TABLE I.

Effect of treating superphosphate with ammonia on the nodulation and yield of subterranean clover.

Treatment		Percentage nodulated plants	Number of nodules per plant	Dry weight of tops
Soil lime per acre	Fertiliser per acre			
(cwt.)	(lb.)	%		(mg. per plant)
0	superphosphate 224 below seed	18	0.6	18
0	superphosphate 224	50	2.4	19
	superphosphate 224: $CaCO_3$ 224	100	7.8	20
	ammoniated superphosphate 236	100	11.9	53
	superphosphate 224: $(NH_4)_2$ SO_4 45 ..	18	0.6	35
5	superphosphate 224	40	1.8	18
	superphosphate 224: $CaCO_3$ 224	95	8.0	26
	ammoniated superphosphate 236	100	10.8	57
	superphosphate 224: $(NH_4)_2$ SO_4 45 ..	43	3.0	39
20	superphosphate 224	100	10.2	29
	superphosphate 224: $CaCO_3$ 224	100	19.8	51
	ammoniated superphosphate 236	100	18.7	66
	superphosphate 224: $(NH_4)_2$ SO_4 45 ..	88	5.8	49
Significant difference for P = 0.05			3.60	7.8
P = 0.01			4.66	10.6

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RETENTION OF CARROT MOTLEY DWARF VIRUS IN *CAVARIELLA AEGOPODII* (SCOP.) FOLLOWING A MOULT

The term vector-direct was suggested by Day and Irzykiewicz (1954) for viruses transmitted on the mouthparts of vectors and the term vector-latent for those transmitted by a more complicated mechanism involving ingestion and re-injection with the saliva. A pre-requisite for admittance of viruses into the latter group, is the existence of a well-defined latent period between virus acquisition by the vector and the development of infective ability.

In the case of the carrot motley dwarf virus a clearly defined latent period was

TABLE I.

Infections recorded on A. leptophyllum from individual aphias before and after moulting.

Pre-moult transmissions	+ + + + + · · + + + + + — — + + — — — + — +
Post-moult transmisisons	+ + + + + · · + + + + + • + — • — — — • + +

+ = Infection recorded.
- = Infection not recorded.
• = Aphid dead or missing at time of transfer.

not apparent in some experiments conducted by the writer, but occurred in others (Stubbs, 1948). This virus was, therefore, listed by Day and Irzykiewicz (1954) in a group of non-persistent viruses which it does not resemble in other respects.

In order to determine the correctness or otherwise of this grouping an experiment was conducted to ascertain whether the vector retained the ability to transmit following a moult.

In the experiment aphids approaching the moulting stage were selected from a clone of *Cavariella aegopodii* (Scop.) bred on infected carrot. These were caged singly on healthy slender celery (*Apium leptophyllum* (D.C.) F. Muell.) seedlings. They were inspected at intervals during the next three days and those which had moulted and become alates were transferred to further test plants. The results of this experiment in which 50% of the aphids transmitted both before and after moulting are recorded in Table I.

The experimental results indicate that the mechanism of transmission of the carrot motley dwarf virus by *C. aegopodii* is ingestion followed by re-injection during feeding. It is considered that the risk of the vector obtaining virus in infective concentration from the test plant on which it fed before moulting, and for a short period after moulting before transference is a negligible one, as slender celery is a poor virus source plant and great difficulty was experienced initially in recovering the virus from this host. Moreover, it would be expected that if the aphid became re-infected during the short interval which elapsed after moulting before transference to the second indicator plant, the concentration of virus ingested would be very low, and transmission efficiency would be reduced in post-moulting transfers.

It can be seen from the results, however, that of the aphids which transmitted and were recovered for the second transfer, 13 produced infections before moulting, while 14 produced infections after moulting. Also, symptom development occurred almost simultaneously in all plants, the minimum incubation period in the plant being 13 days.

References.

Day, M. F., and Irzykiewicz, H. (1954)—On the mechanism of transmission of non-persistent phytopathogenic viruses by aphids. *Aust. J. Biol. Sci.* 7: 251-273.

Stubbs, L. L. (1948)—A new virus disease of carrots: its transmission, host range, and control. *Aust. J. Biol. Res. B*1: 303-332.

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NEWS ITEMS

New Laboratories for the W.A. Dept. of Agricutlure

Approval has been given by the State Cabinet for the erection of laboratories for the Department of Agriculture to cost £300,000 at South Perth. The laboratories will consist of two two-storey reinforced concrete buildings. The construction will be spread over the next three financial years, including the current 12 months to June 30th next.

At present the Department of Agriculture is housed in widely separated buildings. The Head Office in St. George's Terrace will have to be demolished in a year or two to make way for the new Town Hall. By then it is hoped that the South Perth buildings will be sufficiently advanced in construction to accommodate all the professional staff of the department.

Poultry Research Station

On 30th September the Department of Agriculture's Poultry Research Station at Herdsman's Lake, 6½ miles from Perth, was officially opened by the Minister for Agriculture, Mr. Hoare.

Experimental work in progress is concerned with the testing of 110 diets with the object of finding out to what extent high energy diets can be fed to poultry.

Breeding work is projected with the aim of improving the genotype in the State. Mr. L. Gaffney, an officer of the Poultry Branch, is at present in the U.S.A. studying poultry breeding at Purdue University, Indiana.

Artificial Insemination Centre at Wokalup

An artificial insemination centre has been established at the Wokalup Research Station which is about 60 miles south of Perth. An Advisory Committee on which are represented the Dairy and the Veterinary Branches of the Department of Agriculture, the Farmers' Union and the Breeds Society has been formed.

This year the entire Wokalup herd was artificially inseminated and next year it is planned to expand activities in the district.

Eliminating Losses in Stored Wheat

The prospect of Australia having to store immense quantities of wheat for an indefinite period focuses attention again on C.S.I.R.O.'s successful wartime research on the control of pests in stored grain. The results of this work enabled the Australian Wheat Board to store, with insignificant loss, the huge amount of wheat which accumulated during the 1939-45 war.

Simple precautions, in the nature of "good housekeeping," can do much to minimize losses. The risk of infection can be reduced by spraying or fumigating or using smoke generators inside the empty bins or depots. Mineral dusts to which insecticides DDT or BHC have been added provide a good safeguard against insect pests. If an infestation does develop it may be controlled by fumigation.

The C.S.I.R.O. Division of Entomology, which has been responsible for this research, is now examining the possibility of using a new technique—storage in air-tight silos. It believes that this method which has been adopted in Argentina and elsewhere could be successfully employed in Australia.

It is reliably reported that wheat has been kept in air-tight storages in Argentina for as long as six years without loss. This method of storage obviated losses and the expense of implementing pest control measures such as fumigation, and it is claimed that the wheat remained in first-quality condition. With standards of food hygiene rising all over the world some importing countries are reluctant to accept wheat which is even only lightly infested, so that these advantages could be very important, particularly at times when markets are difficult to capture.

Control measures are summarised in C.S.I.R.O. Leaflet No. 11, together with an account of current work on air tight storage.

New Director of the Waite Institute

Dr. J. Melville has been appointed Director of the Waite Agricultural Research Institute. Dr. Melville has held the position of Director of Grasslands Division of the Department of Scientific and Industrial Research, New Zealand, since 1952. Prior to that he was Director of Plant Chemistry Laboratory, D.S.I.R., New Zealand. He served in the New Zealand Army during World War II in the South West Pacific. Dr. Melville will commence duties early in 1956.

Professor J. E. Prescott, who will retire at the end of this year, has been Director of the Waite Institute since the beginning of 1938.

Conference on Soil Conservation

The Australia-wide Standing Committee on Soil Conservation opened the annual conference in Toowoomba during October. This year Queensland is the host State. The Commonwealth Departments of Commerce and Agriculture, the Interior and Territories, as well as the six States are represented on the Committee. The Toowoomba conference was under the chairmanship of *Mr. W. J. Cartmill.* The first part of the meeting was a tour of the major agricultural areas to familiarise members with the problem of soil conservation in Queensland and to examine the progress that has been made there. Starting from Kingaroy, the committee inspected soil conservation progress in the red volcanic soil types of the South Burnett, followed by the developments on the black soils of the Darling Downs. A study of the soil conservation measures adopted on the sloping country of the Eastern Downs, immediately south of Toowoomba was also included.

New Root Stock for Pears

In trials at the Bathurst Experiment Farm of the N.S.W. Department of Agriculture Packham's Triumph pear trees on *P. calleryana* rootstock have yielded up to five times as much fruit as those on the normal *P. communis* stock. The best strains of the new stock, D6 and P.C.3 were superior to all other stocks tested.

Torpedo Grass

Torpedo grass (*Panicum repens*) is thriving on poor sandy soils near the sea on the North Coast of New South Wales. Under these extreme conditions where no other grass will grow well it is a useful fodder plant. However the weeds officer of the New South Wales Department of Agriculture considers that it could become a major problem if allowed to become established on better soils, because of its coarseness, great vigour and strong underground runners.

Dickson Station Field Day

The Division of Plant Industry, C.S.I.R.O., held a Field Day at its Dickson Experiment Station in Canberra on Wednesday, October 5th. There were some 300 visitors to the Station, composed largely of graziers from the surrounding districts. There was also a strong contingent of officers of other divisions located in Canberra and of district agronomists of the N.S.W. Department of Agriculture.

There were eight individual demonstration points, at which pasture utilisation, ley farming, pasture nutrition, plant introduction trials, subterranean clover and lucerne genetics, legume establishment and weed control were dealt with.

In addition to those aspects of immediate practical application, and therefore of direct benefit to graziers, background material showing the development of research projects to ultimate field use was also dealt with.

The afternoon sessions were opened with an informal talk by Sir Ian Clunies Ross, Chairman of C.S.I.R.O., in which he dealt with the integration of the Division's pastoral research programmes and the improvements which had been already effected by C.S.I.R.O. efforts. He spoke further of possible future benefits and envisaged an increase in fertility in the Southern Tablelands to the stage where an altered agricultural and pastoral industry would be warranted.

Visit of Dr. T. H. Harrison to Rome

Dr. T. H. Harrison, Director of Plant Quarantine, Commonwealth Department of Health, made a flying visit to Rome in September to be one of a group of nine experts in Plant Quarantine called together to advise the Director General of F.A.O. on the International Plant Protection Convention.

This Convention was approved by F.A.O. at its sixth Session in 1951, and 30 Governments, including Australia, have become parties to it.

At its seventh Session in 1953, F.A.O. decided to recommend a meeting of technical experts to consider amendments to the Convention.

The Director General invited all parties to the Convention to send in suggestions for the more effective working of the Convention and/or amendments in the Convention.

Replies were received from 26 Governments. The Committee spent a busy week reviewing these suggestions, and in preparing a report to the Director General of F.A.O.

Nicholas Institute for Veterinary and Medical Research

The Nicholas Institute for Medical and Veterinary Research will be opened by the Prime Minister, the Right Honourable R. G. Menzies, P.C., in a formal ceremony at "Burnham Beeches", Sherbrooke, Victoria, early in December. The Institute has been established by Nicholas Proprietary Limited to undertake research in pharmacology, biochemistry and veterinary science.

The Institute occupies the home built by the late Mr. A. M. Nicholas, one of the joint founders of the company, in the Dandenong Ranges some 25 miles east of Melbourne. The reinforced concrete structure of four storeys has been modified to provide laboratories of modern and attractive design while the outbuildings and farm facilities have been adapted to accommodate experimental animals and flocks of sheep and poultry. The property comprises some 170 acres, including 100 acres of sown pastures.

The Pharmacology Section is under the leadership of Dr. G. A. Bentley, formerly of the Baker Medical Reesarch Institute. Six research officers have been appointed to work chiefly on the pharmacology and biochemistry of analgesics, their modes of action and their antagonists, and on new drugs and alkaloids.

The Veterinary Section is undertaking research in two fields, nutrition and parasitology, chiefly with sheep and poultry. Staff and facilities have been assembled to study initially vitamin and mineral metabolism and helminth and coccidial infection. Six research officers and the Director, Mr. A. K. Sutherland, formerly of the Queensland Department of Agriculture and Stock's Animal Research Institute at Yeerongpilly, have been appointed.

Mr. A. B. Cashmore, M.Sc., formerly of C.S.I.R.O., is Technical Secretary of the Institute.

Plant Pathology Laboratory at Kingaroy

During September a plant pathology laboratory was opened at Kingaroy by the Queensland Department of Agriculture and Stock to serve the South Burnett area. The new laboratory is an additional facility to aid agricultural production in the district. Expansion in agriculture has been associated with outbreaks of disease in certain of the cultivated crops, notably crown rot of peanuts and stem rot of cowpeas. *Mr. G. S. Purss* has been transferred from Brisbane to take charge of the laboratory.

New Disease of Rockmelons

An outbreak of a specialised rockmelon strain of Fusarium wilt occurred near Sydney early in 1955.

All local varieties have been found to be very susceptible but, in glass house tests, other cucurbits were not attacked. The disease is well known in North America where it seriously interfered with the growing of rock melons until resistant varieties were developed. One of these is being tested in Sydney by the Department of Agriculture.

Round Fence Posts—Preservative Oil Treatment

Small round posts if properly treated can make a strong and durable fence, according to C.S.I.R.O.'s Division of Forest Products. With proper treatment, they will last as long as split posts of naturally durable timbers.

A survey made in 1953 by the C.S.I.R.O. Division of Forest Products in co-operation with State Departments of Agriculture, showed that most Australian farmers prefer wooden fence posts to posts made of steel or concrete, particularly when the former are cheap and long lasting.

However, whereas timbers that would yield posts with a life of 20 to 50 years without preservative treatment were once common, supplies of such timbers have been greatly reduced, and in some areas they have been virtually or completely cut out. When building new fences or renewing old ones, therefore, many farmers are faced with the alternatives of paying high prices for naturally durable posts brought from a considerable distance, of using costly steel or concrete posts, or of falling back on timbers of lower natural durability readily available locally.

In some countries the preservative treatment of timbers which would otherwise fail rapidly from decay or insect attack is a well-established means of overcoming the problem of shortage of naturally durable fence post timbers. Experience with millions of round posts treated with reliable preservatives shows a life of 20 to 30 years or more, irrespective of the timber used.

In 1930 tests were commenced in Western Australia by the Division of Forest Products to see what happened in Australia. Round posts of several non-durable timbers, including both native timbers and plantation-grown radiata pine, were treated with a variety of preservatives, using the hot and cold bath treatment, and were set in fence lines in localities of severe decay or termite hazard. *After 24 years the great majority of these posts, treated with creosote oil, are still in very good condition and an average life of 30 years is now assured for this treatment.* In some cases, all posts are still very sound and a life far in excess of 30 years seems possible. Untreated round posts of several of the timbers used, set in the test lines for comparison, lasted only from three to six years.

The result of the Western Australian tests is being repeated in similar tests in Victoria and New South Wales, which were commenced in 1936. There is now no doubt that the good results being obtained in other countries can be repeated regularly in Australia.

Where naturally durable timbers are not readily available, preservative treatment provides a reliable method of obtaining from timbers of low natural durability posts that will last as long as, or may even outlast, posts cut from durable timbers. The economic soundness of using treated posts in preference to untreated, naturally durable posts must, however, be worked out in each individual case.

Q.D.O. Bursary at the Queensland University.

The Queensland Dairymen's Organisation will grant bursaries to sons of members who would not have the opportunity of taking a Queensland University course without some financial aid. Under an agreement reached the Q.D.O. will provide for one graduate in agricultural science by means of a bursary of £300 a year to cover a four-year course.

Arid Zone Tour

R. A. Perry, of the Land Research and Regional Survey Section of C.S.I.R.O., organized a two weeks' tour of arid areas of Central Australia for a number of specialist scientists.

The participants were Dr. F. W. Went, California Institute of Technology; Dr. O. H. Frankel, Chief of Division of Plant Industry, C.S.I.R.O.; R. M. Moore, Assistant Chief, Division of Plant Industry, C.S.I.R.O.; Dr. L. A. T. Ballard, Division of Plant Industry, C.S.I.R.O.; W. M. Nunn, Department of Agriculture, W.A.; Professor Cavalcanti, Professor of Agricultural Geology, University of Brazil, and Dr. C. G. Stephens, Division of Soils, C.S.I.R.O.

R. E. Winkworth and N. Forde, officers of the Land Research and Regional Survey Section, stationed at Alice Springs, and G. Chippendale, Botanist, Animal Industry Branch, N.T. Administration, accompanied the tour for three days near Alice Springs.

The tour started at Rockhampton Downs, a cattle station near the edge of the Mitchell grass plains of the Barkly Tableland, where the average annual rainfall is 14 inches and almost all of it falls during the summer months. A few miles south of Rockhampton Downs there is a sudden change from treeless, Mitchell grass plains on the heavy clay soils of the Barkly Tableland to scattered low trees and shrubs and spinifex of the lighter textured lateritic soils.

From Tennant Creek to Alice Springs there is a gradual decrease in rainfall and an increase in the proportion of winter rainfall. The country changes from gravelly lateritic soils with sparse trees and shrubs over spinifex to broad sand

plains carrying spinifex. Mulga becomes increasingly prominent approaching Alice Springs.

From Alice Springs the party deviated to the west through the MacDonell Ranges to Standley Chasm, Hermansberg and Palm Valley and then returned to Alice Springs.

The Simpson Desert was next visited. Here the party crossed 8 or 10 low dunes near the edge of the desert and climbed Window Hill, a lateritic mesa which rises above the dunes.

From Alice Springs to Oodnadatta, the mean annual rainfall gradually decreases and also changes to a winter maximum. Chenopodiaceous plants dominate most of the heavier textured soils and mulga the lighter.

From the vegetation point of view it was fortunate that most of the area had experienced one of the best seasons for many years. The ground everywhere was covered with a luxuriant growth of herbs and grasses which gave a false impression of the area.

International Wool Conference.

Many of the delegates who attended the First International Wool Conference in Australia during August have suggested that the conference should become a regular event, held every five years.

A committee of conference members, formed shortly after the conference commenced, passed a unanimous vote to this effect, and suggested that planning of arrangements should commence three years in advance. The general feeling was that the meeting should again be held in Australia if this was possible.

The tours through the wool growing districts were thought to be amongst the most valuable features of the conference. Many overseas delegates were intensely interested to see pasture development work, particularly the value of subterranean clover and trace elements in raising the carrying capacity of large areas.

Report of Conference

A full report on the First International Wool Conference is being prepared by C.S.I.R.O. and is expected to be available by March, 1956.

New Horticultural Research Station

First plantings of citrus trees have been completed on a new horticultural research station established by the N.S.W. Department of Agriculture in the Coomealla irrigation area at Dareton on the lower Murray. The Coomealla Research Station has been designed to provide a service to citrus growers on the lower Murray and will be of special benefit to the many new settlers on orchard blocks in the area.

Back Numbers of Journal Wanted

The following back numbers of the Journal are now out of print, and copies have been requested by oversea and Australian public libraries:—

Vol. 1 (1935), Nos. 1 and 2 (March and June).

Vol. 2 (1936), Nos. 1 and 4 (March and December).

Vol. 10 (1944), Nos. 1, 3 and 4 (March, September and December).

Vol. 15 (1949), No. 1 (March).

Vol. 16 (1950), No. 4 (December).

Vol. 20 (1954), No. 3 (September).

The Business Manager wishes to buy from members any of the above issues for which they have no further use. He will pay 5/- per copy.

Visiting Scientists

The recent F.A.O. conference on "*Animal Production under Tropical Conditions*" brought more than fifty delegates and observers from many countries to Brisbane.

Some of the overseas delegates attending the conference were:—

Dr. Saphon, Director of Veterinary Services, Cambodia.

Mr. H. K. Lall, Deputy-Director of Animal Husbandry, Uttar Pradesh, India.

Prof. Mohamad Rosa, Professor at the Veterinary Faculty, University of Gadjahmada, Indonesia.

Mr. Katsuichi Aida, Hidaka Livestock Breeding Station, Hokkaido, Japan.

Dr. F. C. Kraneveld, Professor in Tropical and Protozoan Diseases, University of Utrecht, Netherlands.

Dr. P. Hoekstra, Director of the Institute for Animal Husbandry Research, Utrecht, Netherlands.

Dr. C. P. McMeekan, Ruakura Animal Research Station, Hamilton, New Zealand.

Dr. S. M. Sarwar, Director of Animal Husbandry, Punjab.

Dr. P. V. Berina, Veterinary Officer in Charge, National Slaughterhouse, Manila.

Dr. J. G. Black, Acting Deputy Director of Veterinary Science, Northern Rhodesia.

Dr. W. J. A. Payne, Animal Husbandry Officer, Sigatoka, Fiji.

Mr. W. E. Lancaster, Director of Veterinary Services, Federation of Malaya.

Dr. Clair E. Terrill, Beltsville U.S.D.A. Animal Research Station, Maryland.

Dr. D. Dien, Animal Production Services, Saigon.

Dr. K. V. L. Kesteven, F.A.O. Animal Production Branch, Rome.

Sir Thomas Dalling, Veterinarian, F.A.O., Rome.

Mr. N. R. Joshi, F.A.O. Animal Production Branch, Rome.

Dr. R. O. Whyte, Agronomist, F.A.O., Rome.

Professor F. W. Went, Professor of Botany at the Californian Institute of Technology, who was in Australia at the invitation of the Plant Industry Division of the C.S.I.R.O., returned to America in October. Professor Went is, of course, famous for his phytotron at Pasadena which is the biggest collection of controlled conditions for growing plants in the world. He was in Australia for three months and discussed controlled conditions for growing plants with workers here and visited most of the arid areas of Australia to further his interest in desert plants. Professor Went is also very interested in smog damage to plants and saw evidence of smog damage to two species in both Sydney and Melbourne. He pointed out that this was not unexpected as, in his experience, plant damage from

gasoline vapours is likely when the consumption of petrol reaches a level of about 12 tons per square mile per day.

Dr. R. O. Whyte, Agronomist of the Plant Protection Board, F.A.O., recently spent some time in Australia visiting all States. He was able to see many aspects of agronomic work including plant introduction at Canberra.

During his tour Dr. Whyte addressed meetings in several centres.

Mr. K. Harrow head of the plant protection section of the Division of Plant Pathology, D.S.I.R., New Zealand, spent some time in Australia meeting workers in the plant protection field.

Dr. Kiang Ai Kim, Lecturer in Chemistry at the University of Malaya, spent some weeks with the Division of Industrial Chemistry, C.S.I.R.O., studying techniques as a prelude to his making a phytochemical survey of Malaya.

Dr. H. P. Olmo, Professor of Viticulture, Davis, a Fulbright Fellow, who has been working at the Institute of Agriculture, University of W.A., since February, left on 29th October to return to the U.S.A. via Europe. For the nine months he was in W.A. Dr. Olmo was primarily engaged on the yield decline and replant problems of the dried fruit section of the viticultural industry.

Dr. R. L. M. Synge, of the Rowett Institute Aberdeen, spent a week in Perth whilst on his way home from the Wool Textile Conference in Sydney.

The Curriculum in Agricultural Science at Sydney University—New 3 Year Degree Course Introduced.

The course in Agricultural Science at Sydney University is being altered, and the alterations have now been approved by the Senate. The changes were the subject of a symposium at a meeting of the N.S.W. Branch on 16th September, 1955. Professor J. R. A. McMillan, Dean of the Faculty of Agriculture, outlined the changes and the reasons for them, and Professor J. M. Vincent spoke about the proposals as they affect Honours courses.

In the course for Bachelor of Science in Agriculture, there would be three specific courses.

A. A general course, which would give a basic training up to the end of the third year, and then in the fourth year allow specialisation in nine (9) fields of Agricultural Science.

B. A course in Agricultural Economics, which would be a specialised course, with a marked bias towards Agricultural Economics commencing in the first year and developing entirely along those lines over the whole four years.

C. A course in Animal Husbandry, which would be very similar to the A. General Course but with its bias towards Animal Husbandry rather than Agronomy. This course would allow specialisation, after the third year, in nine separate fields during the final fourth year.

A notable departure from the existing course was a Bachelor of Agriculture Degree at the end of third year, after which the basic training common to all courses will have been completed. This Bachelor of Agriculture degree would be particularly suitable for—

1. Extension workers in the Department of Agriculture and similar authorities:
2. For teachers, and—
3. For those men entering private enterprise.

The courses to be available are shown in the following groupings, Group B being primarily for Agricultural Economics and Group C for students wishing to specialise in Animal Husbandry.

1st Year	A.	B.	C.
Agr. Economics 1	—	X	—
Botany 1	X	X	X
Chemistry 1	X	X	X
Economics 1	—	X	—
Elements of Agr.	X	X	X
Physics 1	X	—	X
Zoology 1	X	X	X

2nd Year	A.	B.	C.
Agr. Botany	X	X	X
Agr. Chemistry 1	X	—	X
Agr. Economics 2	—	X	—
Agronomy 1	X	X	X
Animal Husbandry 1	X	X	X
Economics 2	—	X	—
Economic Statistics	—	X	—
Soil Science	X	X	X

3rd Year	A.	B.	C.
Agr. Chem. 2	X	—	X
Agr. Economics 1	X	—	X
Economics 3	—	X	—
Agr. Entomology	X	—	X
Agr. Microbiology	X	—	X
Agronomy 2	X	X	X
Animal Husbandry 2A	X	X	X
Animal Husbandry 2B	—	—	X
Genetics	X	—	X
Government 1	—	X	—
Plant Pathology	X	—	—
Statistical Methods	X	—	X

4th Year	A.	B.	C.
Agr. Chem.	X	—	X
Agr. Economics	X	X	X
Agr. Entomology	X	—	X
Agr. Genetics	X	—	X
Agr. Microbiology	X	—	X
Agronomy	X	—	X
General Agriculture	X	—	X
Plant Pathology	X	—	—
Soil Science	X	—	X
Animal Husbandry	—	—	X

Professor McMillan explained that the amended course aims at turning out three types of graduates:

1. Those with broad general training.
2. Those with broad training and broad specialisation.
3. Those with broad training and intensive specialisation.

In his opening remarks Professor McMillan stated that a recent survey disclosed that Governments and Government agencies in Australia would require some 800 graduates in the next five years and that, in his opinion, private industry would need at least 200. At the present rate of training only about 400 will be available. It was strongly suggested that the new three year degree course in Agriculture would attract more students and appreciably lessen the serious shortage of graduates in Agriculture. It was considered that it would provide very satisfactorily the broad general training required by extension workers, teachers in agricultural schools, farmers and technical officers for such as C.S.I.R.O.

Professor Vincent pointed out that, originally, Honours at graduation were awarded on the aggregate achieved in four years work. Later some specialisation for Honours students was introduced in the fourth year. This was followed by the introduction of a fifth year for Honours and this scheme has turned out Honours graduates well trained for research work. Under the new scheme Honours will be awarded at graduation after four years. It is now considered that a five years course is too long and that the new proposal will permit a reasonably satisfactory preparation for a research career and an equitable basis for assessing the relative worth of graduates and will permit more students to undertake Honours work.

In the past the work done in the fifth year for Honours has often been up to the standard of that required for an M.Sc. degree and graduates wishing to prepare for an M.Sc.Agr. or a Ph.D. degree have been at a disadvantage in that often excellent work done for Honours cannot be presented for a higher degree.

There was considerable discussion of the changes in the course by the many members present and some strong views were expressed. The general opinion of the meeting was that the re-arrangement of the four year course leading to a B.Sc.Agr. degree was a commendably progressive step.

However, there was strong opposition to the introduction of a second and inferior degree in Agriculture after three years work.

It was felt strongly by many speakers that the introduction of the three years' degree would lower the status of the profession and lower the high academic standing of the Faculty of Agriculture, both of which should be very much the concern of the Institute. Doubt was expressed whether this proposal would attract many more students and it was felt that this would be better achieved by stepping up the publicity campaign which has already proved to be effective. Professor McMillan pointed out that the standard of the B.Agr. degree would be at least equal to that of the B.Sc. degree. One speaker expressed the firm conviction that two standards from the Faculty of Agriculture would lead to confusion, to the disadvantage of the B.Sc.Agr. graduate, especially in the field of private employment. There would be direct competition between Hawkesbury Agricultural College diplomates and holders.

Reference was made to the fact that the Education Department in New South Wales was extremely short of University trained teachers. At the present time fewer than 30 of the 125 teachers of agricultural subjects in high schools are graduates. It was pointed out that graduates in agriculture are at a disadvantage in the teaching profession, teachers with B.A. or B.Sc. degrees get the same rewards with less training than those with a B.Sc.Agr. degree. However the effect of the introduction of the shorter course on the supply of teachers could not be reliably forecast.

Concern was expressed that the proposed course in Animal Husbandry could be completed in three years; it was felt that four years' training was essential for extension workers in this rapidly widening field. More than one speaker thought that specialisation in the B.Sc.Agr. course might well start even earlier than is proposed, i.e., in the third year.

While the N.S.W. Branch has, in the past, shown too little active interest in the training of agricultural scientists there is no doubt that these changes in the curriculum at the University of Sydney have stimulated great interest. It was felt, that in giving expression to this interest, the Institute should endeavour to take a broad national view of the problem, aiming essentially at uniformity of standards between the different Universities while, at the same time, jealously guarding the status of the profession of agricultural science.

The subject was again discussed at a general meeting of the N.S.W. Branch held on 29th September, 1955, and the following motion was passed:

"That the Management Committee (of the N.S.W. Branch) be asked to set up a representative committee to enquire into the training of agricultural scientists in this State, and that, pending the findings of this sub-committee, the appropriate University authorities be asked to defer further action on the recommendation from the Faculty of Agriculture concerning the proposal for the introduction of a three year course leading to the degree of Bachelor of Agriculture."

The Committee of Management met and considered this request and decided to set up a well-qualified sub-committee having the following terms of reference:

1. To enquire into the desirability or otherwise of the proposed introduction of a Bachelor of Agriculture degree at the University of Sydney.
2. To investigate training in agriculture and related fields at relevant tertiary institutes such as Universities, Agricultural Colleges and Teachers' Training Colleges.
3. To consider the use being made of graduates and diplomates by employers in so far as it relates to training and entry into the profession.
4. To consider any other related aspects which the sub-committee may feel to be important.

The Committee of Management felt that the work of the sub-committee should aim at providing the basic material for a State conference on the subject which should be held during May, 1956.

Plant Nutrition Conference

Melbourne, 27th February to 2nd March, 1956

Approved last December by the Agricultural Council, the broad purpose of the Conference is to bring together Australian research workers in plant nutrition. The discussions will be limited to the more fundamental aspects and the wider principles of greatest current interest in Australia. Proposed agenda:—

A. *Nutrient Requirements of Plants and Diagnosis of Deficiencies.*

1. Uptake and Utilization of Nutrients. *Chairman*: Dr. C. R. Millikan.

2. Diagnosis of Nutritional Deficiencies and Excesses.

(a) By use of indicator plants; (b) by chemical analysis of plants; (c) by chemical analysis of soils; (d) by bio-assay; (c) pot culture techniques. *Chairman*: Professor G. W. Leeper.

B. *The Distribution and Role of Nutrients in the Plants.*

1. Distribution, Movement and Function of Nutrients. *Chairman*: Professor J. G. Wood.

2. Interactions between Nutrients in the plants. *Chairman*: Dr. C. S. Piper.

3. Effects of Deficiencies and Excesses of Nutrients on the Morphology and Quality of the Plants.

C. *Inter-relation of Legumes, Rhizobia and Nutrients. Chairman*: Mr. A. J. Anderson.

D. *Cultural and Other Environmental Factors which suggest new approaches to plant nutrition or new principles for consideration. Chairman*: Mr. A. G. Strickland.

Papers submitted will be printed and also a report of discussions.

The Department of Agriculture, Victoria, is responsible for convening the Conference. Mr. F. M. Read is Chairman of the Organizing Committee.

Attendance will have to be limited to nominees of C.S.I.R.O., Departments and Universities.

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TALKS

"Some Soil Problems in North America, England and India"

Professor L. J. H. Teakle, Professor of Agriculture, University of Queensland

Soil science has developed into a healthy baby, able to stand on its own feet and to demand service from the older brothers in science, Chemistry, Physics, Geology, Botany, Zoology, Bacteriology and so on. Like most babies, Soil Science is not quite sure of itself; is not sure which path it will take on a number of questions; in fact, it is not at all sure just what are the basic qualities of a soil.

Modern soil classification has its origin in the Russian School led by Dokuchaev who published a dissertation on soils in 1879. The Russians observed that the profile was the characteristic of a soil as a natural body and they developed the conception of the features of this profile being the resultant of the soil-forming factors of which they enumerated 5, parent material, climate, vegetation, time and relief. The correspondence between large areas of soils of similar profile and climatic zones led them to the zonal concept of soils—soils within a zone not conforming to these profile features were classed as Intrazonal and Azonal. This concept and the definition of broad soil types such as Podzols, Chernozems, Chestnut Soils and Solonetzes, now known as Great Soil Groups, are the basis of most modern systems of classification. These may be regarded as Genetic classifications as the processes and factors presumably concerned with the development of the profile are given considerable weight—even paramount over the observable features.

There is now a very strong move to develop an objective or factual system of classification in which the measurable soil characters are the basis for classification. Gedroiz and de Sigmond tried to introduce this 30 years ago, but were unsuccessful. Australian attempts have not yet succeeded. The U.S.D.A. Soil Survey Section, led by Dr. C. E. Kellogg and Dr. Guy D. Smith, is developing a new classification based on profile characters selected on account of their presumed genetic significance. This has been widely discussed in the U.S.A., Canada, Western Europe and Africa and should emerge as a working plan within the next year.

While overseas many soil profiles were examined and photographed. Some of these were the Podzols, characterised by an undulating layer of organic matter below the light coloured A2 horizon; the Prairie (Brunizem), Chernozem and Chestnut (Dark Brown) soils characterised by a dark surface rich in organic matter and a lighter-coloured, prismatic subsoil; dark-coloured Grumusols or self-swallowing soils of Texas and India which have their counterparts on the Darling Downs; the Red Yellow Podzolics, with which some of the coastal Podzolics and Red Earth Residuals of Australia appear to have affinities. From an examination of soils of the northern hemisphere it would appear that the names applied to some widespread Australian soils have been unfortunate.

Agricultural management not in harmony with the environment and soil characteristics leads to soil deterioration. Cultivation of wheat without renovating crops has led to loss of 30 per cent. organic matter on the Saskatchewan prairies—reminiscent of Victorian experience; subsurface compaction of the black clay soils of Texas (Grumusols) has followed the use of heavy cultivating implements and endeavours to correct the trouble involve rotation with clover, cereal grazing crops and the use of deep-cultivating drills; soil erosion due to wind and to water action is evident in many areas. Wind erosion is being reduced by listing, strip cropping and trash fallowing; water erosion by grade banks and rotation farming. Soil fumigation with D.D. is an important practice in the renovation of some Californian orchard soils.

Soil testing is big business in the U.S.A., England and Holland as an aid in Extension services. States in the U.S.A. which were visited tested from 10,000 to 100,000 samples a year, the usual charge being $1 per sample. In Holland, one laboratory near Wageningen tests 150,000 samples annually.

There has been a great increase in use of inorganic fertilisers throughout North America. In the U.S.A., consumption has increased from 7,300,000 tons pre-war to 20,500,000 tons in 1950. The percentage analysis has increased and the ratio N: P_2O_5: K_2O is 1.0: 1.7; 1.1. India is just realising the value of inorganic fertilizers—particularly ammonium sulphate. The whole output of the Sindri works in Bihar, producing 960 tons per day, has been absorbed and more is needed.

"Frost, its Prediction and Control"

Mr. B. Mason, Meteorological Department, Adelaide

Of the meteorological factors which affect frost occurrence in South Australia dynamic factors determining cold air mass movements are of less importance than in Europe. Static factors due to the air mass over the area at the time are most important because they influence heat balance between the sun and the earth and its atmosphere.

Mr. Mason explained in detail the differences in temperature and spectrum range of the sun and earth, what happens to the sun's heat when it reaches the atmosphere and the earth's surface and how these change during each day leading to temperature inversion and stability of air near the surface.

The principles of frost prediction were illustrated by referring to the Barossa Valley frost of 25th September, 1954, which was predicted

after conditions of wind, cloud and humidity had been considered. A calm surface is needed for inversion development and experience has shown that if the wind speed at 2000 ft. is less than 20 m.p.h., surface inversion will be strong enough to damp out any surface eddying. Cloud more than 50 metres thick acts as a black body radiator and it also prevents the escape of radiations of 7-11μ to which the atmosphere is normally transparent. Both factors retard surface cooling. Moisture absorbs long-wave radiation completely at some wave lengths and partially at 7 to 8μ and 11 to 14μ. The latter has a big influence on frost. Experience has shown that when the dew point exceeds 42°. there is no likelihood of frost but when less than 36°F., risk is high.

Topographical features are not so important in forecasting but have a big influence on local frost occurrence. Large temperature differences due to contour have been shown at Loxton Irrigation Area. Impeding air damage can increase frost hazard.

Frost control was considered under five headings:

1. Cultural practices. Protection of 2°F. can be obtained by early cultivation and allowing the soil to pack as compared with freshly cultivated soil. Weed growth raises "ground" level. Also a healthy crop is less liable to frost damage.
2. Frost pots give a protection of from 3°F. to 7°F. due to an increase in the eddy diffusivity factor, not to direct heating as is commonly held. The stronger the inversion the better is the protection afforded by frost pots.
3. Smudging to reduce radiation is not used now because it must be dense, land must be flat and it is a nuisance.
4. Wind machines increase ground temperatures by creating convection as warmer air from above is pulled down. Their effectiveness has been disappointing, as a machine gives too little protection for its high cost.
5. Overhead watering is used on the Continent. Plants are protected by a covering of water which releases heat when it freezes. Soil irrigation gives some protection by increasing soil conductivity but this diminishes quality and is lost 3 or 4 days after the irrigation. Irrigation has a great advantage in that it settles the soil.

"Buffel Grass"

S. J. Marriott, Chief Agrostologist, Dept. of Agriculture and Stock, Queensland.

Mr. Marriott demonstrated that buffel grass (*Cenchrus ciliaris*) or a related species is capable of proving one of the biggest single factors in increasing livestock production in Queensland, even outstripping the benefit derived from cactoblastis, which solved our prickly pear problem 25 to 30 years ago.

Buffel grass is a perennial summer species with strongly developed tufted habit of growth. It has a deep spreading root system with buds for stem development produced slightly below ground level. These characteristics give it good drought resistance and protection from overgrazing.

The grass entered Australia between 1870 and 1880 by accidental introduction from India as an escape from camel harness. The place of entry was Wallal, a coastal settlement some 150 miles E.N.E. of Port Hedland, in Western Australia. Its entry into Queensland was more deliberate. Since 1930, some 97 separate seed lots of various species of *Cenchrus* have been introduced. The largest acreage has been established in the Cloncurry district. Scattered stands used by stock occur throughout the Burnett and Callide Valleys and also in areas around Jericho, Blackall, Yalleroi and Richmond. In addition, large numbers of pilot plots and small commercial areas have been made throughout most of pastoral Queensland, including small plots near Boulia and Laura.

Suitable areas for buffel grass in Queensland may be summarised in these general terms:— (i) in the tropics, where the dry season is prolonged, (ii) gidyea country and the drier parts of brigalow scrub lands receiving less than 25 inches of rain per annum, (iii) red loams, brown sandy loams and clay loams of the northern and north-western open-forests, particularly the extensive channels along the Cloncurry, Leichhardt and Flinders rivers, (iv) the red desert lands of central western Queensland and some of the spinifex country. It will not persist on the infertile spinifex soils, where it responds to uneconomic N.P.K applications.

A source of cheap seed is the major limiting factor in its establishment. In pastoral areas with current beef and wool values, it is considered that seed costs preclude massive sowings. A cheap home-made stripper for seed collection fitted in front of a motor vehicle would be of immense value to pastoralists who could then harvest seed from country negotiable by that vehicle.

The logical methods of establishment are strip and island plantings in strategic areas, e.g., strips across slopes or at right angles to prevailing winds or island areas on crests of ridges. On friable land, broadcasting seed in front of travelling stock is successful. Best results will follow if seedlings set seed, before being stocked.

Commercial strains of buffel grass in Queensland are the Gayndah, Western Australian and type D, introduced by C.S.I.R.O. Information on the strain aspect is being assembled at Brian Pastures Research Station where further strains from W.A. and C.S.I.R.O. introductions are being tested. Wide variations exist within buffel grass. This grass produces seed apomictically, and therefore strains can be maintained easily in a state of uniformity.

Evidence regarding the value of buffel grass was quoted, for example, at Port Hedland (W.A.) where the annual rainfall is 10 to 12 inches and where the dominant native vegetation is spinifex, a sheep property with 60,000 acres of buffel grass out of a total of 580,000 acres has trebled the normal carrying capacity.

Further figures were offered to support the argument that buffel grass could play a major

role in Queensland where large areas of pastoral lands exist with more fertile soils and better rainfall than in N.W. Western Australia.

"The Agricultural Research Council"

Dr. C. J. Magee, Chief Biologist, Dept. of Agriculture, N.S.W.

In the early days agricultural research in U.K. was not organised at all but grew up following the action of individuals (e.g., Rothamsted) or associations of farmers or horticulturists (e.g., Long Ashton and Cheshunt). First government money for agricultural research became available in 1909 with the setting up of a Development Commission, and in 1931 the Agricultural Research Council was set up. The main function of the Agricultural Research Council is to increase the efficiency of food production in Great Britain. It is a body of fifteen members chosen for their knowledge of agriculture and science. Not less than ten of the members are chosen on account of their eminence in one of the sciences and are appointed with the advice of the President of the Royal Society. They retire after five years service. The Council is appointed by and responsible to the Committee of the Privy Council for Agricultural Research and is on a similar footing to the Medical Research Council and the Department for Scientific and Industrial Research. The A.R.C. has a permanent secretariat and employs a senior scientific staff and a number of senior executive officers.

The A.R.C. supervises the State-aided research institutes (21 in number, including Rothamsted, East Malling, Long Ashton, John Innes, Cheshunt, etc.) and administers fourteen of its own institutes and units and assists fundamental and applied research in universities. It maintains close liaison with the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland. The Council endeavours to review, co-ordinate and facilitate all agricultural research in progress and promote new research where necessary. No central direction of research is attempted, this being left to individual workers and the directors of the institutes. Standing committees of the Council, however, periodically examine the staffing, equipment and research programmes and advise the agricultural departments on their financial estimates. The Council's own institutes and units are mainly at universities and a professor or reader at the university is usually the honorary director of an institute.

The impression formed during visits to the research stations and institutes supervised by the A.R.C. was that there was no obvious shortage of finance, equipment was modern, laboratory and workshop facilities were good and the staff seemed keen and was presumably sufficiently well paid. The State expenditure on agricultural research has increased greatly during the last decade—from £400,000 in 1940 to £3,200,000 in 1951. In 1951 the expenditure was 0.3% of the value of the agricultural output in the same year. The organisation impressed me as ideal as it was on a decentralised basis and appeared to be free from red tape—institutes looked after their own affairs and managed their own budgets.

"Some Aspects of Plant Nutrition in California"

Dr. C. M. Johnson, Dept. of Plant Nutrition, University of California, Berkeley

Dr. Johnson outlined the part played in Californian agriculture by the University of California which has work going on at several different centres throughout the State, all under one central administration. Berkeley, Davis and Riverside are concerned with agriculture. Stanford University, the University of Southern California and the California Institute of Technology are separate organisations. In the University of California work in agriculture had the three functions of teaching, research and extension.

Dr. Johnson outlined features of the physiography, climate, water conservation and general land utilisation of California as background data for a brief statement concerning the activities of the extension services in soils. Nitrogen is the main fertiliser used, applications are often very large; phosphate and potash are important particularly for truck crops. Zinc is very widely used but the amounts used are small as would be expected. Test plots are used to show the effects of fertiliser practices. For example, it was shown that phosphate fertilisation of barley was not effective unless adequate amounts of nitrogen were used also. The results of nitrogen from such plots may be arranged graphically to show the profit and loss in terms of yield from different rates of the two fertilisers.

The work of tracking down plant nutrition problems brought in by the extension services was discussed by Dr. Johnson. Poor growth of lucerne in pastures of the Northern Valleys of California, altitude 4,000 ft., was one such problem. The lucerne showed a yellow top which looked like boron deficiency but no responses to boron at the usual rates of application could be obtained. However, field trials using large amounts of superphosphate and boron at 4 cwt. and 100 lbs./acre, respectively, produced good quality lucerne. This problem is being studied at present. The possibility of phosphate fixation due to such materials as allophane must not be overlooked.

Another problem tracked down was the farmer prejudice in favour of ammonia rather than nitrate fertiliser as a source of nitrogen in the southern part of the great valley of California. The soils are sandy, calcareous with a near neutral reaction. In a glasshouse trial symptoms of phosphate deficiency were obtained in tomatoes using nitrate as a source of nitrogen. These symptoms did not appear when ammonia was used as the nitrogen source. It was established that the soil contained phosphatic compounds of the form $Ca_x\ H_y\ (PO_4)$. Ammonia by a reaction of the form $NH_4 + 2O_2 + 2H + H_2O$ increased the H ion concentration in the soil causing a release of (PO_4) ion. Soil acidified by other means, e.g., with sulphur, also released (PO_4) ion. (The soil is not sulphur deficient).

Nitrate can be used as a nitrogen source on this soil if sufficient phosphate is added also.

Other problems tackled are of the plant nutrition department's own choice and Dr. Johnson instanced his work on chlorine nutrition which arose out of a proposed investigation aimed at finding out the effect of elements, known to be useful to animals, such as cobalt, sodium and iodine, on plants. Cobalt was chosen and its source greatly purified. Plants did not grow well even in the controls. This was traced to a lack of chlorine and the symptoms found in tomato were described. It was shown that these were not related to the cation associated with the chloride. Tomato cannot set fruit in the absence of chlorine and thus it is an essential nutrient. The atmosphere is a good source of chlorine, as was demonstrated, so that chlorine deficiency in the field is unlikely. Chlorine deficiency symptoms have been demonstrated in a number of plants including lucerne, sugar beets, lettuce, subterranean clover and cabbage, which fails to develop its characteristic odour. Chlorine deficiency in tomato plants grown at the Waite Institute by Dr. Johnson was demonstrated.

"Some Aspects of Soils Research in California"

Professor R. L. Crocker, Professor of Botany, Sydney University.

The University of California, Berkeley, has one of the two or three best soils departments in the world. It was founded by Hilgard who was one of the first to recognise climate as a soil forming factor.

The soils of California do not fit very well into the Great Soil Groups; they are particularly variable, ranging from very old surfaces to regions affected by comparatively recent earth movements. Altitude ranges from below sea level to over 14,000 feet. The soils are best described in terms of physiographical features: Upland Soils and Valley Soils.

Prof. Crocker described the various soils with the aid of colour slides.

Although much original work has been done to determine the essential elements for plant growth, there is very little need for the use of trace elements in California. Phosphate, sulphur and nitrogen are used in top dressing.

Extensive hard pans are an important problem.

"Farm Water Conservation"

H. J. Geddes, Lecturer-in-Charge, University of Sydney, McGarvie Smith Animal Husbandry Farm, Badgery's Creek, N.S.W., and E. Smith, Principal Engineer, Water Supplies Section, Water Conservation and Irrigation Commission of N.S.W.

Mr. Geddes started by saying that water is the most important factor in crop production yet the farming lands of the world receive, on the average, about twice as much water as they need. Particularly in Australia rainfall is generally badly distributed. The speaker stressed the importance of storing water locally. Farm storage of water is much cheaper than large scale public irrigation schemes and, with the developments in dam-making and spray irrigation techniques, is applicable and profitable almost everywhere.

The question of how much a farmer can afford to spend on water is a difficult one but it must be asked, and answered. As one example a farmer is profitably spending £7/10/- an acre-foot on pumping water from a deep well for irrigating lucerne. The fuel cost for pumping is small—Mr. Geddes stated that one acre-foot of water can be lifted one foot for one shilling's worth of diesel fuel. Investigations have shown that, for profitable operation of a farm water storage and irrigation scheme, the gross return should be more than twice the cost. It has been shown at Badgery's Creek that, in producing milk for city milk supply from irrigated pastures, gross returns of the order of £100 per acre can be obtained for the expenditure of less than £20 per acre for water.

When adequate water is available the quality of the soil does not matter much in producing feed for dairy cows. On the poor soils at Badgery's Creek up to 35 tons of greenstuff has been produced per acre.

The basis of the farm water storage scheme developed at the McGarvie Smith Farm is a series of comparatively small "ring" dams. In these part of the water is stored below ground surface level in the excavation and the greater part stored above ground surface level within the walls formed with the excavated material. The speaker said that it is very much cheaper to pump water in to fill such a dam, from a small collecting dam, than it is to excavate for a gravity fill. The importance of evaporation is commonly exaggerated and in any case water is never stored for very long as the effect of rain, even heavy rain, on a (pasture) crop does not last for more than about 10 days. By then irrigation is required to maintain maximum growth.

Mr. Smith outlined methods of construction and maintenance of small dams and emphasized the importance of care and thoroughness in the construction of the walls which must be properly consolidated. To allow for maximum run-off at times of heavy rainfall and avoid damage to the dam a proper by-pass must be built. The storage: excavation ratio is all important in determining costs of water storage. With excavation costing 2-3/- per yard a ratio of 3:1 must be obtained for costs of water compared with water costs in a large irrigation area. Successful water storage dams cannot be constructed in all soils, the soils in the Badgery's Creek area are particularly suitable. Much work is being done on stabilising pervious soils with bituminous emulsions or using bituminous sheeting, covered with 12-18 inches of compacted soil to make dams in unstable soils hold water, but these methods are not yet entirely successful.

There was much discussion by members and visitors who included representatives from the "Men of the Land" Society, the Animal Production Society and the Irrigation Development Society.

The question was asked whether it was better to collect water in dams or keep it in the

ground over the watershed. Mr. Geddes replied that in the Nepean catchment the run-off averaged 39 per cent. and it was aimed to collect one-third of this in dams. He pointed out that pastures do not grow feed in dry periods and that to ensure maximum production any water deficit should be avoided. Recent research indicates that more frequent watering may greatly improve the response of pastures to phosphate. There is a real weakness in the lack of research into the use of water by both pasture and crop plants. By applying water more logically there should be real hope of obtaining more crop with the same amount of water. Data must be obtained on the relationships between rainfall, ground water evaporation and plant use. It was pointed out that improved pastures need more water, therefore water storage and irrigation must be closely linked with pasture improvement.

The suggestion was made that land use practice must be considered critically in relation to water storage and irrigation. The relative merits of using irrigation to stabilise production or for specialist production must be assessed.

"Changes in Animal Husbandry in California during the past Twenty Years"

Prof. G. Hart, Veterinary School, University of California.

Professor Hart opened his address by expressing pleasure in finding that the Institute is a national body of broad interests embracing both Agronomy and Animal Husbandry.

He pointed out that California experiences regular droughts and has many problems similar to those in Australia. The area of the State is 100 million acres, with a total arable area of 20 million acres of which 5½ million are irrigable. The irrigable land is used for a large asparagus industry and many other vegetables are produced on such a scale as to provide a large proportion of the requirements of other States.

Scientific studies made to determine the feeding value of rangeland plants have shown that before blossoming they provide a good diet for beef cattle, but seasonal variations cause fluctuations in quality and quantity.

Experiments have been carried out to determine the effectiveness of supplemental feed given at various times of the year and at different stages of development of the animal.

The results emphasised the importance of continuous growth. Animals that lose or maintain weight in the dry feed or winter season will gain faster during the following green feed season than comparable animals that have made continuous gains due to supplementary feeding; the starved animals, however, will never catch up.

A high plane of nutrition early in life followed by a lower plane results in carcasses higher in lean and lower in fat than when the reverse occurs, even though the same final weight is obtained at the same age. High planes of nutrition speed up the development of thickness growth generally, especially in later maturing parts such as loin and hindquarter.

"Some Recent Developments in Marketing Overseas"

H. S. Hunter, Director of Marketing, Dept. of Agriculture and Stock, Queensland

The last of the United Kingdom rationing schemes was terminated last year. The open market now is the established order overseas with supplies of agricultural products, in some cases, more than adequate to meet demands. The remaining controls in the United Kingdom, which takes 40 per cent. of our rural exports (excluding wool) are for the most part controls to facilitate the orderly liquidation of food stocks accumulated under the Government contracts. The world market is dominated also by the vast stockpiles of agricultural produce in the United States produced under the stimulus of the U.S. Government's support price schemes.

In other countries agricultural production has increased until supply has overtaken demand. Governments overseas have retreated somewhat from the wartime and immediate post-war policy of subsidies and support prices, but their new policies are tempered by their determination to maintain a solvent and even prosperous agriculture.

This is the case in America because the Americans have learnt that the nation cannot prosper if agriculture is depressed. It is the case in Britain for reasons of security and because of the necessity to produce more of her own food needs in her changed financial situation.

Overseas producers are meeting intensifying competition by measures designed to reduce costs and improve quality. Protective measures are taken also to prevent an undue depression of the price level. In the marketing field very good work is done by the integrated activities of growers' co-operatives and statutory control bodies.

Economic and marketing research in the United States impresses, especially in the lack of a time lag in putting findings into commercial operation. There is a constant aim to improve efficiency in the production of farm products at the point of sale, at the right time, and place, and in the best condition, at the lowest possible cost. Large sums of money are found for the purpose by Government, the Universities, Co-operatives and private industry.

The United States in its internal marketing of foodstuffs has developed practices and techniques which are of great interest to us. Supermarkets and chain stores all equipped with an extensive system of deep freeze cabinets are to be found throughout the country. Practically all modern household refrigerators have a deep freeze chamber. Against this background of retail store and household refrigeration a system of prepackaging has been developed embracing meats, vegetables, fruits and other foodstuffs put up in cellophane wraps and in quantities to meet the needs of various kinds of customers. Furthermore, this pattern of retailing is endeavouring to fit itself in to the motor age. High speed roads, on which traffic is unimpeded by crossings because of the elaborate system of clover leaf overpasses and underpasses, mitigate big city traffic conges-

tion by a quick getaway of long distance vehicles. Highly perishable foodstuffs are being carried over these roads in large numbers of refrigerated trucks and semi-trailers and wholesale markets of modern design for fruit and vegetables have been built adjacent to the motor highways, often beyond city limits.

These developments are of interest to us because the Brisbane Market was designed to serve a much smaller population than the city supports today and a mode of transport that has been superseded by the motor truck.

Sydney, New South Wales, is currently giving consideration to the removal of its fruit and vegetable markets from Ultimo to Flemington.

We are interested also in similar developments in South Africa and in the development there of a pineapple growing and canning industry which may compete strongly with Queensland canned pineapple in the U.K. and Canadian markets. The Henry Jones Canning interests, employing Australian experts, are in the forefront in establishing a South African pineapple industry.

BOOK LIST

Notice has been received that the following books on agricultural topics have been published recently:—

AUSTRALIA, Commerce and Agriculture, Department of—Dairy Farming in Australia: Western Australian Edition. Melbourne, Department of Commerce and Agriculture, 1955.

DAVIS, J. G.—A dictionary of dairying. 2nd ed. London, *Leonard Hill*, 1955. 65/- stg.

GREAT BRITAIN, Ministry of Agriculture and Fisheries—Costs and efficiency of pig production: a comparison between England and Denmark. London, H.M.S.O., 1954. 2/- stg.

————, Ministry of Agriculture and Fisheries—T.B.4. The calculation of irrigation need. London, H.M.S.O., 1954.

————, Ministry of Agriculture and Fisheries—The farm as a business. A handbook of standards and statistics for use in farm management advisory work. London, H.M.S.O., 1954. 4/-. stg.

————, Ministry of Agriculture and Fisheries — Tractor ploughing. 3rd ed. London, H.M.S.O., 1954. 3/- stg.

HAWKESBURY AGRICULTURAL COLLEGE — Plant diseases conference, June, 1955. Melbourne, C.S.I.R.O., 1955.

JACKS, G. V.—Soil. London, *Thomas Nelson*, 1954. 12/6 stg.

REMINGTON, John Stewart and FRANCIS, Wilfrid. The manure and fertiliser notebook. London, *Leonard Hill*, 1955. 12/6 stg.

ROSE, G. J.—Crop protection. London, *Leonard Hill*, 1955. 30/- stg.

SMALL, James—Modern aspects of pH. London, ... *Baillière, Tindall and Cox*, 1954. 20/- stg.

WYLIE, J. C.—Fertility from farm wastes. London, *Faber and Faber*, 1955. A. 41/6.

PERSONAL NOTES

Mr. H. A. Mullett.

Retirement of Mr. H. A. Mullett.

Mr. H. A. Mullett, I.S.O., B.Agr.Sc., retired on 22nd September, 1955, after nearly 23 years as Director of Agriculture in the Victorian Department of Agriculture.

Important milestones with which Mr. Mullett was closely identified included the outstanding results from topdressing of natural pastures with superphosphate at the Rutherglen State Farm and later in the Western District and other parts of Victoria; the discovery by Mr. Mullett of Wimmera Rye Grass and his recognition of its potential value; the development of a wheat breeding programme which has paid substantial dividends to the State, and the establishment of the Better Farming Train under Mr. Mullett's supervision which, in its novel way, marked the beginning of further progressive moves in the development of the Department's extension services.

In 1946, Mr. Mullett visited the United States of America as a member of a Commonwealth delegation on soybeans and later attended a meeting of the Food and Agriculture Organisation at Copenhagen.

Mr. Mullett was a foundation member of the Victorian Branch of the Australian Institute of Agricultural Science and was Branch President in 1942.

Professor J. A. Prescott Awarded Honorary Life Membership.

At Council's meeting on 13th October, 1955, Professor J. A. Prescott, Director of the Waite Agricultural Research Institute, was unanimously awarded Hon. Life Membership of the Australian Institute of Agricultural Science. Professor Prescott has had a long and distinguished career in Australia, and is well known to Australian agricultural scientists. Since coming to Australia in 1924, he has consistently pursued the general objective of adding to the knowledge of Australia as an environment for agriculture.

His earlier work was concerned almost entirely with soils. He brought to this task modern schemes of soil classification, the value of which was not then widely appreciated in this country. This work was largely crystallised in his well-known "Soil Map of Australia", first published in 1931, and since revised.

In later years Professor Prescott has given more and more attention to the climatological aspects of the Australian environment. He has paid special attention to the study of rainfall and evaporation and their relationship to the moisture status of the environment.

Professor Prescott has been Waite Professor of Agricultural Chemistry in Adelaide since 1924, and Director of the Waite Institute since 1938.

He was awarded the C.B.E. in 1947 and elected a Fellow of the Royal Society in 1951. In recognition of his contributions to scientific knowledge Professor Prescott was awarded the Farrer Medal in 1948 and the Australian Medal of Agricultural Science in 1950.

Australian Capital Territory

Miss Janet Friend has resigned from C.S.I.R.O. Canberra, where she has worked in the Microbiology Section for the last four years. She sailed in September for a grand tour of the United Kingdom and the Continent.

Dr. Frankel, Dr. Ballard and *Mr. Moore* accompanied Professor Went on a tour of the arid zones of Australia which was organized and led by Mr. Perry of the Regional Survey Section of C.S.I.R.O.

Miss Burbidge has also returned from a collecting trip into Central Australia. The good rains in that area made conditions for collecting both plants and insects excellent.

Dr. T. H. Strong visited Paris in September to attend the biennial meeting of the Permanent Agricultural Committee of the International Labour Organization at which the current problems of rural labour placement and share farmers were discussed. He also visited Rome and Geneva for discussions with the personnel of the Economics Division of F.A.O. and the International Committee for European Migration.

Mr. C. S. Christian, Officer-in-Charge of the Land Research and Regional Survey Section of C.S.I.R.O., who is also the Australian Liaison Officer for Arid Zone Research, recently returned from a six months' tour overseas.

The primary purpose of this visit was to study arid land problems in other countries, but opportunities were also taken to pay a short visit to Mahaicony-Abary and Wageningen mechanized rice development schemes in British Guiana and Surinam respectively and also to recruit staff in the United Kingdom, Holland and Germany.

Mr. Christian attended the U.N.E.S.C.O. Arid Lands Symposium and Conference in New Mexico as one of Australia's delegates and then made an extensive tour of the arid and semi-arid States of the U.S.A.

Because of the comprehensive nature of his Section's activities in the arid parts of Australia Mr. Christian made many contacts in a very wide range of interests, including range ecology and range management; water resources; watershed studies; arid land hydrology; dry-land agriculture; climatic studies and integrated regional survey.

During the return trip from the United Kingdom, a period of two weeks was spent in the more arid portions of Israel, including a week's visit to the Negeb where both modern and ancient water-spreading practices were examined.

In Pakistan Mr. Christian inspected the Commonwealth Livestock Farm in the Thal desert area of the Western Punjab on behalf of the Department of External Affairs and was there able to make a study of the impact of irrigation on an arid area which had been subjected to nomadic grazing and seasonal and annual cropping for many centuries.

New South Wales

Mr. J. R. G. Morschel has resigned from the position of District Plant Pathologist at Leeton in the Department of Agriculture and has joined the Division of Plant Quarantine of the Commonwealth Department of Health.

Mr. C. Brickhill, District Entomologist at Leeton in the Department of Agriculture, is at present holding an assistantship in the University of California and is stationed at Berkeley where his special interests are citrus pests and the problem of red spider on fruit trees.

Mr. A. D. Mears has resigned from the Department of Agriculture and is now on the staff of Micro Chemicals Ltd. in Sydney.

Mr. D. Pollock is bacteriologist with the Riverstone Meat Co.

Mr. T. Cook is an agricultural representative on the staff of Elliotts and Australian Drug Ltd.

Mr. J. Turner has been appointed to C.S.I.R.O. and is with the Northern Territory Land Survey Unit.

Mr. I. D. Hall has been appointed Manager, Philips-Rokane (Australia) Pty. Ltd. The company is interested in agricultural chemicals and pharmaceuticals.

Mr. E. Friend, who was agronomist at Bathurst Experiment Farm, is now Agricultural Officer on Norfolk Island.

N.S.W. Graduates in New Guinea.

Mr. W. L. Conroy, who is Chief of the Division of Agricultural Extension, D.A.S.F., Papua and New Guinea, was recently Australian Representative at the International Rice Commission Conference at Tokyo.

Mr. A. W. Charles, Economic Botanist for the Territory of Papua and New Guinea, recently visited Singapore as Territory delegate to the South East Asian Plant Protection Convention. He also visited the Rubber Research Institute at Kuala Lumpur and arranged the purchase of some of their highest yielding rubber clones.

Mr. J. W. Barrie is now District Agricultural Officer, stationed at Lae.

Mr. S. Saville, who recently resigned from the New South Wales Department of Education, has taken up duty in New Guinea as an Agricultural Officer.

Some 1955 *Graduates*

Mr. P. Baumgartner has joined the N.S.W. Department of Agriculture as a plant breeder.

Mr. D. Finlay is on the staff of the Agriculture School at the University of Sydney where he is assisting Professor Watson with the course work in genetics and plant breeding.

Mr. I. McLean has joined the Department of Agriculture as an agronomist.

Messrs. *W. Bryant, I. Holford* and *W. Muirhead* have joined the N.S.W. Soil Conservation Service.

Mr. J. Wheatley is attached to the Economics Section of the Agriculture School at Sydney.

Mr. M. Campbell has been appointed to the staff of the Commonwealth Bank in Sydney.

Mr. J. Charley is doing post-graduate work in Ecology at the New England University.

Mr. J. Bohanna has joined the staff of a firm of land valuers in Sydney, and *Mr. P. Nicharen* is working with a flour-milling firm also in Sydney.

Errata

Dr. D. E. Shaw. In the last issue (21:207) it was stated that Dr. Shaw was "plant pathologist at the University of Sydney". This is not so as she resigned from the University in August, 1953, before going overseas.

Mr. D. J. Goodchild. In the last issue (21:207) it should have also been stated that Mr. Goodchild, who was awarded a Fulbright Fellowship, was a Science Research Student in plant pathology at the University of Sydney at the time the award was made.

Queensland.

Mr. W. J. S. Sloan, Director of Agriculture, Department of Agriculture and Stock and two officers of the Commonwealth Department of Health were chosen as delegates to represent Australia at an international seminar on nutrition and health education. The seminar, which was arranged jointly by the World Health Organisation and the Food and Agriculture Organisation of the United Nations, was held in the Philippines during October. Delegations were sent by approximately 20 countries in the Western Pacific, South and East Asia and Pakistan. The purpose of the seminar was to deal with social, cultural and economic problems that have a bearing on improved nutrition, and the educational methods to be adopted to raise the standard of public health.

The Commonwealth Government appointed *Mr. A. F. Bell,* Under Secretary, Department of Agriculture and Stock as the Australian delegate to a world conference which was held in Rome, during November, under the auspices of the Food and Agriculture Organisation of the United Nations. Before attending the Rome conference, Mr. Bell attended talks held in London to review the working of the Commonwealth Sugar Agreement which was concluded in 1951.

It is with keen regret that the death of *Dr. J. H. Riches* is placed on record. Dr. Riches was associated with animal production in Queensland for 18 years. He supervised the establishment of the Gilruth Plains national field station for research into animal health and production at Cunnamulla.

In 1946 he made a survey of merino wool in eastern Australia and became known to many graziers. Dr. Riches started research into blowfly body strike in sheep at the C.S.I.R.O. station at Yeerongpilly in 1951, and was engaged on this work when he died.

Mr. P. J. Skerman, Senior Lecturer in Agriculture, University of Queensland, recently returned from a survey of the east coast of Cape York Peninsula, as a continuation of the assessment of the agricultural potentialities of the State which he began as an officer of the Bureau of Investigation. Finance was made available by the Rural Credits Fund of the Commonwealth Bank of Australia.

Mr. S. J. Marriott has been appointed to the position of Chief Agrostologist, Department of Agriculture and Stock, Queensland.

Mr. J. H. Saint-Smith was transferred to the Bureau of Tropical Agriculture, South Johnstone, as an agronomist in charge of investigation into tropical pastures and crops.

Many Branch members of the Institute attended the F.A.O. conference on "Animal Production under Tropical Conditions", including *Drs. N. T. M. Yeates, E. M. Hutton* and *Messrs. A. F. Bell, H. G. Turner, J. F. Miles, J. F. Kennedy, G. D. Hubble, S. J. Marriott, J. G. Young,* The conference was under the chairmanship of *Mr. A. F. Bell.*

Mr. W. W. Bryan, Senior Agronomist, Plant and Soils Laboratory, C.S.I.R.O., spent one week in early October inspecting the pasture developmental investigations conducted by the Department of Agriculture and Stock in North Queensland.

Dr. G. Coleman, Biochemist, Plant and Soils Laboratory, C.S.I.R.O., attended the International Wool Textile conference held in August at Sydney, Geelong and Melbourne. His main interests at the conference were the sessions on amino acid and protein chemistry.

Dr. R. N. F. Langdon has been appointed Acting Professor of Botany, University of Queensland, during the absence of *Professor D. A. Herbert.* During 1956, Professor Herbert will spend his twelve month study leave period overseas

Victoria

Mr. P. Ryan took up his duties as Victoria's new Director of Agriculture on Sept. 22nd.

Mr. Ryan who had previously been Chief Inspector of Agriculture in the Department, brings to the position a wide knowledge of Victorian agriculture and considerable administrative experience.

Mr. J. Brake, Superintendent of Agriculture in the Victorian Department, retired on November 11th. Mr. Brake joined the Department in 1915 and after a brief period enlisted for war service. For some years after the war he was farming, and he rejoined the Department in 1924.

Mr. Brake rose to Senior Inspector of Agriculture and subsequently in 1934 he became Superintendent of the Agricultural Division.

Mr. R. G. Downes has returned from the United States after spending a period on a Commonwealth Fellowship studying soil conservation practices.

Mr. A. B. Hackwell, who is attached to the Scientific Liaison Office in London, is at present in Australia for a short period and has been able to see many of his Victorian friends. He is visiting C.S.I.R.O. centres in all States.

Mr. F. Skaller, Officer-in-Charge of the C.S.I.R.O.'s Poultry Research Centre, Werribee, will attend the Technical Meeting on Poultry Production in Asia and the Far East as a guest of the Food and Agriculture Organisation of the United Nations (F.A.O.). This conference has been organised by F.A.O. and will be held at Poona, India, from 17th to 27th October. Mr. Skaller has been invited by F.A.O. to address this conference on the subject of *"Improving Poultry Production Through Breeding".*

Mr. Leith Gillespie has resigned his position as Senior Research Officer with C.S.I.R.O. to develop a private practice as an Agricultural Consultant. He is the first Institute Member to launch out on such a venture and we wish him well. Mr. Gillespie's business address is 36 Somers Av., Malvern, Victoria. Telephone: UY 1895.

South Australia.

Mr. L. J. Cook, Chief Agricultural Adviser of the Department of Agriculture, retired recently after more than 40 years in the Department.

Mr. J. C. M. Fornachon has been appointed director of the newly-formed Australian Wine Research Institute.

Mr. Rowland Hill, Executive Officer, Lands Development Executive, was awarded the O.B.E. in the last Birthday Honours.

Mr. J. A. Beare, formerly Senior Research Officer of the Soil Conservation Branch of the Department of Agriculture, has been appointed Soil Conservator.

Dr. L. H. May has been appointed head of the Department of Plant Physiology, Waite Agricultural Research Institute.

Mr. J. M. Fisher has been appointed Nematologist in the Department of Plant Pathology, Waite Agricultural Research Institute.

Western Australia

Mr. R. Moir, Senior Lecturer and *Mr. M. Somers*, Research Officer, of the Institute of Agriculture, University of Western Australia, and *Mr. E. Munch-Petersen*, of C S.I.R.O., will attend a conference on Digestion in Ruminants to be held in Canberra, in November.

Dr. D. P. Drover, Lecturer in Soil Science, Institute of Agriculture, University of Western Australia, departs for England in December on 12 months' study leave. He will be working at the Macaulay Institute for Soil Research, Aberdeen, under Dr. E. G. Williams, Acting Head of the Soil Fertility Department.

Mr. M. Cullity, Superintendent of Dairying, Department of Agriculture, presided at the Annual General Meeting of the Society of Dairy Technology held at Adelaide in October.

Mr. J. Lawson and *Dr. B. Rumich* have resigned from the Department of Agriculture.

Mr. R. Bettenay, Dairy Branch, Department of Agriculture, has been transferred from Denmark to Perth where he is Acting Dairy Husbandry Officer.

Mr. G. Burvill, Commisioner for Soil Conservation, attended the annual meeting of the standing committee on soil conservation which was held in Queensland in October. As a prelude to the meeting the members inspected soil conservation work in the Kingaroy and Darling Downs areas.

Mr. T. C. Miller, formerly Assistant Superintendent of Horticulture, left on October 8th for South Australia to take up an appointment as Superintendent of Horticulture in the South Australian Department of Agriculture.

Sir Ian Clunies Ross, Chairman of C.S.I.R.O., and *Mr. Gill*, Chief of the Division of Animal Health and Production, were in Western Australia in September. During their visit they made a brief tour of the Murchison district.

Mr. D. Johnston, who is on leave from the Department of Agriculture, was a delegate to the International Horticulture Congress which met at Wageningen, Holland, in August.

NOTICE OF GENERAL MEETING

Notice is hereby given that the Twenty-fourth Annual General Meeting of the Australian Institute of Agricultural Science will be held in the School of Agriculture, University of Melbourne, at 8 p.m. on TUESDAY, 28th February, 1956, and continued at 8 p.m. on WEDNESDAY, 29th February, 1956. All Institute members are invited to attend.

Agenda.

28th February, 1956.

1. Formal Business: Credentials, Proxies. Standing Committees.
2. Opening Address by the President for 1955, Dr. H. C. Forster.
3. General Business:
   (a) Minutes of the 22nd General (Annual) Meeting, 15th March, 1955, and the 23rd General (Special) Meeting, 16th August, 1955.
   (b) Report of Council for the year 1955.
   (c) Report of the Editor for Vol. 21, 1955.
   (d) Audited Statement of Accounts and Balance Sheet for Vol. 21, 1955.
   (e) Report of the Business Manager for Vol. 21, 1955.
   (f) Budget for Vol. 22, 1956.
   (g) Audited Statement of Accounts and Balance Sheet for the Institute for 1955.
   (h) Audited Statement for A.J.A.R. Distribution Account.
4. Report of Council concerning the award of the Australian Medal of Agricultural Science for 1956.
5. Report of Council concerning the election of the President for 1956.
6. Discussion: The Institute, and the Future.
7. Any other business.
8. Adjournment.

29th February, 1956.

Presidential Address: (Deferred from the 22nd General Meeting) by I. F. Phipps, Ph.D., M.Sc., B.Agr.Sc., Technical Manager, Biological Division, I.C.I.A.N.Z. Ltd., who was the President for 1954.

THE COMPOSITION OF INSTITUTE MEMBERSHIP

The accompanying table summarises the composition of Institute membership from 1936 to 1953. It is based on the lists of members and their occupations published in this Journal in 1935-36, 1940, 1947 and 1953. These lists are the only record available of agricultural scientists, and the services in which they were employed at those times. It is believed that Institute membership would include between 60-75% of all agricultural scientists so that the table may be interpreted as showing the composition of the profession as a whole in Australia.

Despite rises in numbers in all categories, except the University of Adelaide, considerable changes in the percentage composition are evident. The most notable are the fairly steady decrease in the percentages employed in the State Public Services, except in South Australia, and the rapid increase in percentage of members in private employment—mainly farming—in the post war period.

BRANCH NOTES

Australian Capital Territory

The 119th General Meeting was held at University House on August 25th at 8 p.m.

The President, R. M. Moore, was in the chair and 15 members and visitors were present. The President reported briefly on the Council in Person meeting which he had attended on 17th August.

Dr. Alan E. Terrill, Head of the Sheep Experiment Station, Dubois, spoke on the principles of breeding at Dubois.

The 120th General Meeting was held in the C.S.I.R.O. Meeting Room on October 5th at 8 p.m.

The Vice-President, Dr. D. B. Williams, was in the chair, and 19 members and 51 visitors were present.

The meeting was arranged for the visitors to the Field Day at Dickson Experiment Station.

In opening the meeting the chairman gave the visitors a brief outline of the aims of the Institute. The meeting took the form of a general discussion leading on from the work which had been seen at Dickson during the day.

New South Wales

At a special general meeting of the Branch held on 16th September, 1955, the main business was a symposium on "The course in agricultural science at the University of Sydney". The principal speakers were the Dean of the Faculty of Agriculture, Professor J. R. A. McMillan and Associate Professor J. M. Vincent. There was an excellent attendance of 70 members and visitors and the subject was discussed at considerable length. A full report of this meeting and subsequent action taken by the Branch appears elsewhere in this issue.

A symposium on the subject of "Farm water conservation" was the main business of the general meeting held on 29th September, 1955. The main speakers were Mr. H. J. Geddes, Lecturer-in-Charge, Unversity of Sydney, McGarvie Smith, Animal Husbandry Farm, Badgery's Creek, and Mr. E. Smith, Principal Engineer, Water Supplies Section, Water Conservation and Irrigation Commission of New South Wales. There was again an excellent attendance of approximately 70 members and visitors indicating the interest in both the subject and the manner of presentation.

Queensland

At a meeting, held on 27th July, the main business was an address by *Professor L. J. H. Teakle*, Professor of Agriculture, University of Queensland, on *"Some Soil Problems in North America, England and India"*. He visited these countries whilst on study leave during 1954.

A special combined meeting of the Society of Animal Production, Society of Dairy Technology and this Branch (A.I.A.S.) was held on 4th August, to hear *Professor R. J. Boutflour*, Director of the Royal Agricultural College, Cirencester, address the meeting on *"Producing the 2,000 gallon cow"*. The meeting was arranged by the Society of Animal Production.

A special invitation meeting of the Branch, which is a feature in the annual programme of activities since 1952, was held on 24th August. Attendance at this meeting, by persons who are not Branch members, is by invitation. On this occasion, attendance included members of the Queensland Legislature and representatives of leaders in government departments and administration, kindred associations and commercial enterprise. The main business was an address by *Mr. S. J. Marriott*, Chief Agrostologist with the Department of Agriculture and Stock, on *"Buffel Grass"*.

At the September meeting, *Mr. H. S. Hunter*, Director of Marketing, Department of Agriculture and Stock, delivered an authoritative address on *"Some Recent Developments on Mar-*

Members Employed in	Year	A.C.T.		N.S.W.		VIC.		Q'LAND.		S.A.		W.A.		TAS.		TOTAL	
		Nos.	Of Year's Total	Nos.	Of Years Total	Nos.	Of Year's Total	Nos.	Of Year's Total	Nos.	Of Year's Total	Nos.	Of Year's Total	Nos.	Of Year's Total	Nos.	Of Year's Total
State Public Service	1936	1	4%	62	75%	44	67%	20	71%	11	24%	24	92%	14	82%	176	63%
	1940	—	—	83	69%	67	59%	37	71%	19	31%	37	70%	17	94%	260	58%
	1947	—	—	93	54%	77	50%	44	75%	26	37%	49	69%	18	86%	307	50%
	1953	—	—	119	50%	136	46%	60	54%	55	50%	72	59%	23	70%	554	52%
Commonwealth Public Service	1936	24	96%	2	2%	4	6%	2	7%	9	20%	—	—	3	18%	36	13%
	1940	30	97%	8	7%	15	13%	6	11%	15	25%	2	4%	1	6%	77	17%
	1947	55	98%	31	18%	25	16%	6	10%	19	27%	5	7%	2	9%	143	23%
	1953	59	95%	33	14%	43	15%	22	20%	22	20%	15	12%	5	15%	199	19%
Industry Incl. Banks	1936	—	—	10	12%	8	13%	1	4%	2	4%	—	—	—	—	21	8%
	1940	—	—	14	11%	18	16%	1	2%	—	—	1	2%	—	—	34	8%
	1947	—	—	17	10%	29	19%	1	2%	5	7%	4	6%	1	5%	60	10%
	1953	—	—	28	12%	58	20%	4	4%	6	5%	6	5%	3	9%	105	10%
Private Incl. Farming	1936	—	—	4	5%	—	—	2	7%	3	7%	2	8%	—	—	11	4%
	1940	—	—	3	2%	4	4%	1	2%	4	7%	6	11%	—	—	18	4%
	1947	1	2%	20	12%	6	4%	2	3%	3	4%	7	10%	—	—	39	6%
	1953	1	2%	30	13%	38	13%	11	10%	12	11%	16	13%	1	3%	109	10%
Universities	1936	—	—	5	6%	7	11%	3	11%	20	45%	—	—	—	—	35	13%
	1940	—	—	12	10%	9	8%	7	13%	23	38%	7	13%	—	—	58	13%
	1947	—	—	18	10%	13	8%	5	8%	16	23%	6	8%	—	—	58	9%
	1953	—	—	21	9%	12	4%	12	11%	14	13%	12	10%	1	3%	72	7%
Overseas	1936	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1940	1	3%	1	1%	—	—	—	—	—	—	—	—	—	—	2	—
	1947	—	—	5	3%	3	2%	1	2%	2	3%	—	—	—	—	11	2%
	1953	2	3%	7	3%	6	2%	2	2%	1	1%	1	1%	—	—	19	2%
Members in State Public Services 1953				Agric 87 Soil Con. 12 Educ 13 Water 2 Others 4		Agric 110 Soil Con. 9 Educ. 5 Water 5 Others 7		Agric., incl. Soil Con. 51 Sugar 7 Lands 2		Agric., incl. Soil Con. 50 Educ. 5		Agric. incl. Soil Con. 66 Educ. 1 Chem. 3 Others 2		Agric. 22 Health 1			

keting Overseas". The address was supplemented by colour transparencies.

South Australia

On 12th August *Mr. B. Mason* of the Meteorological Department spoke on "*Frost Control and Forecasting*".

On 16th September *Dr. C. M. Johnson* of the Department of Plant Nutrition, University of California, Berkeley, spoke on "*Some Aspects of Plant Nutrition in California*".

On 14th October three speakers contributed to a symposium on "*Development of Kangaroo Island*": *Mr. R. Hill*, Chairman, Land Development Executive, *Dr. C. T. Piper*, Soil Chemist, Waite Institute, and *Mr. E. D. Carter*, Parndana Research Centre, Department of Agriculture.

Victoria

The annual dinner held at the William Angliss Food Trades School on September 27th again proved to be a successful and enjoyable event. Approximately 100 members and guests were present.

On October 4th some 35 members had the opportunity of meeting Professor Went, at a sherry party held at the Central Executive Office. This reception followed an afternoon lecture by the Professor entitled "The Ecology of Desert Plants". The lecture was attended by members of C.S.I.R.O., various State Departments and the University.

Western Australia

At a meeting on September 16th *Mr. B. Williams*, of the Dairy Branch, Department of Agriculture, gave a talk illustrated with Kodachrome slides on his recent tour of the dairying areas of New Zealand.

A film evening was held at the Shell Theatrette on the evening of October 5th. A number of country members who were in Perth for the Royal Show attended.

Dr. R. Rossiter has succeeded Dr. T. C. Dunne as an Institute nominee on the Advisory Committee to the Faculty of Agriculture, University of W.A.

EXTENSION OFFICERS

New Plant Protection Products as a result of research by Australian Departments of Agriculture, C.S.I.R.O. and I.C.I.A.N.Z.

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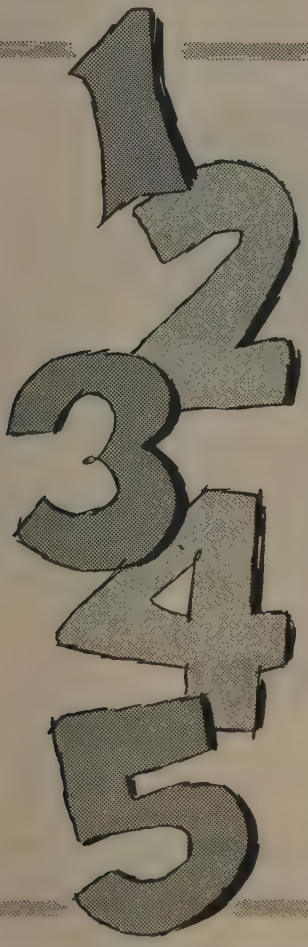

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Every sheep-breeder in Australia knows "Lucy".

She's Lucilia Cuprina—the blow-fly who costs the Australian wool industry about £10,000 a year.

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Recent scientific research has found that sheep "struck" by "Lucy" can be successfully treated with 0.1 per cent. Dieldrin.

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SHELL laboratories are proud of the assistance they are giving Australia's greatest primary industry in the development of these two important insecticides.

PUBLIC SERVICE OF SOUTH AUSTRALIA

Applications for the positions set out hereunder will be received by the Public Service Commissioner, 21 Flinders Street, Adelaide, until and including MONDAY, 9th JANUARY, 1956.

Applicants should state full names, address, date of birth, marital status, academic qualifications, practical experience, and give particulars of war service (if any). Copies only of testimonials should be submitted with the application.

The appointee may be required to contribute to the Government Superannuation Fund.

SALARIES QUOTED ARE ACTUAL.

. . . . .

Agriculture Department

BARLEY AGRONOMIST

Salary range: £1,600—£1,750 per annum.

Duties: Take part in a co-ordinated barley improvement programme involving research and extension by the Department and other bodies. Primary responsibilities of the appointee will be a technical survey of barley quality, organisation of field trials, general extension towards improved barley quality and barley breeding work co-ordinated with that proceeding at other institutions.

Qualifications: Applicants should possess a degree in Agricultural Science, and experience in cereal agronomy.

Accommodation: The appointee will be stationed at the Turretfield Research Centre where a house is available at a rental to be determined.

ASSISTANT ADVISER IN ANIMAL PRODUCTION

Salary range: £900—£1,300 per annum, with opportunity of promotion to higher ranges.

Duties: To advise producers on problems of animal husbandry and production, particularly in respect of sheep, by means of personal contacts, addresses and demonstrations. The appointee will also be required to assist with investigations into problems associated with animal production.

Qualifications: A Degree in Agricultural Science or its equivalent, and practical experience in animal husbandry.

PUBLIC SERVICE OF VICTORIA
DEPARTMENT OF AGRICULTURE

POSITIONS AVAILABLE FOR GRADUATES IN AGRICULTURAL SCIENCE.

Applications, addressed to the Secretary to the Public Service Board, Public Offices, Treasury Place, Melbourne, C.2., will be received up to 25th January, 1956, for appointment to positions in the Department of Agriculture in the following fields:—

* Agricultural Education
Agronomy
Agrostology
Animal Husbandry
Horticulture
Irrigated Agriculture
* Soil Science

Qualifications: A degree in Agricultural Science, or equivalent qualifications.
* For these positions an appropriate Degree in Science, as an alternative qualification, would be considered.

Yearly Salary: (Actual) £1,064, minimum; £1,384, maximum — Agricultural Science Graduates.
£1,038, minimum; £1,384, maximum — Science Graduates.
(Commencing salary in accordance with experience.)

Further details of the positions available may be obtained from the Director, Department of Agriculture, Treasury Place, Melbourne, C.2.

NOTE: Persons completing their final examinations this year are invited to apply.

UNIVERSITY OF MELBOURNE

Applications are invited for the position of PROFESSOR OF AGRICULTURE.

The salary will be £3,000 per annum with superannuation similar to F.S.S.U.

Conditions of appointment may be obtained from the Registrar, with whom applications should be lodged by 15th March, 1956.

F. H. JOHNSON,
Registrar.

APPOINTMENTS AVAILABLE

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

LABORATORY SECRETARY

PLANT AND SOILS LABORATORY, BRISBANE.

Duties: To assist the Associate Chief, Division of Plant Industry, in the scientific and technical aspects of administration of the Brisbane Plant and Soils Laboratory.

Qualifications: University Degree in Agricultural Science, Science, or equivalent qualifications. Experience in administrative work desirable.

Salary: Dependent on qualifications and experience, commencing salary will be determined within the range of Senior Technical Officer, £1,310-£1,562 p.a., or Technical Officer, £890-£1,310 p.a.

Applications, referring to appointment 146/70, should reach the Associate Chief, Plant and Soils Laboratory, C.S.I.R.O., C/o Parliament House Post Office, George Street, Brisbane, Queensland, by 9th January, 1956.

PLANT PATHOLOGIST

THE COLONIAL SUGAR REFINING COMPANY LIMITED

has a vacancy for a

PLANT PATHOLOGIST

at a sugar mill in Fiji.
Permanent Staff Position.

DUTIES: Pathological Investigation of Diseases of Sugar Cane in Fiji and their control.

QUALIFICATIONS: Must have completed pass (preferably Honours) Degree course in Agriculture at approved University. Should have had 2-5 years' experience in practical work in plant pathology, preferably under tropical or sub-tropical conditions with crops or grasses.

AGE: 24 to 30 years.

SALARY: In accordance with age and qualifications £1,265 to £1,530 p.a. (Fiji currency) with prospects of advancement.

CONDITIONS: Accommodation for single man.
Rent free house for married man.
Superannuation Fund.
Passages to Fiji provided.
Eight weeks' leave every two years.

APPLICATIONS: In writing with references to:—

The Staff Officer,
Box 483, G.P.O.,
SYDNEY, N.S.W.

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MANZATE. Manzate is a fungicide based on the chemical Manganese ethylene bisdithiocarbamate. This material has been specially developed for control of fungus diseases in potatoes and tomatoes and in fruit and vegetable crops.

PARZATE. Parzate is a fungicide based on Zinc ethylene bisdithiocarbamate for use against fungus diseases on a wide range of crops, including potatoes.

FERMATE. This is a fungicide based on Ferric dimethyldithiocarbamate. This material is particularly useful for control of tobacco fungus diseases.

METHOXYCHLOR INSECTICIDES. A number of formulations, based on Methoxychlor, are now available. These include Marlate 50, a 50% wettable powder for use on fruit and vegetables, and Marlate 2-MR, an emulsifiable oil, and Dairy Cattle Spray. These last mentioned sprays are for use wherever stock are handled.

C.M.U. WEED KILLER. This material is based on 3-(p-chlorophenyl)-1, 1-dimethylurea. It is a non-poisonous total weed killer, which is effective for long periods. At very low dilution it is ideal for pre-emergence control of weeds in crops as divergent as sugar cane and asparagus.

AMMATE WEED AND BRUSH KILLER. This material is based on Ammonium sulfamate and it is ideal for control of eucalypt suckers and other tree species. It will control Mallee shoots, Crofton weed and most perennial weeds and brush.

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